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ACTION PLAN FOR INTEGRATED SOLID WASTE MANAGEMENT IN NAGGROE ACEH DARUSSALAM, INDONESIA

MARCH 2006

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ACTION PLAN FOR INTEGRATED SOLID WASTE MANAGEMENT IN NANGGROE ACEH DARUSSALAM, INDONESIA

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EXECUTIVE SUMMARY

The Environmental Services Program (USAID/ESP) is a project funded by the United States Agency for International Development (USAID). This project has been implemented under the leadership of Development Alternatives Inc. (DAI) and is designed to provide assistance to government, private sector, NGOs, community groups and other stakeholders to improve the management of water resources and broaden distribution of safe water to urban dwellers by strengthening watershed management and delivery of key environmental services including clean water, sanitation and solid waste management. This action plan has been developed to recommend procedures by which the USAID/ESP project can have a meaningful role in the implementation of effective solid waste management in Aceh Province and in other areas in which the USAID/ESP program is active.

Conceptually, the action plan focuses on the implementation of an integrated solid waste management (ISWM) approach. This concept seeks to engage all relevant participants in solid waste management including solid waste generators, government agencies, community groups and the informal sector in an integrated manner. The key processes associated with ISWM include waste generation, primary collection, secondary collection/transfer and disposal. The ISWM approach also assumes that a significant effort is made to reduce the solid waste stream and recover materials that may have value through reuse, recycle and recovery (the 3Rs). This action plan provides recommendations on how USAID/ESP can assist regional governmental units and community-based organizations in developing effective solid waste management programs for their jurisdictions. It further seeks to integrate USADI/ESP's efforts with the work of a number of donor agencies and NGOs in solid waste management. Some of the current solid waste activities in Aceh Province include the following:

1. USAID, through the Environmental Services Program, is seeking to provide capacity building and design assistance for water supply, sanitation and solid waste management infrastructure development in the region. (This Action Plan aims at identifying the best way in which to provide that assistance.)
2. The United Nations Development Program (UNDP) Tsunami Recovery Waste Management Program is providing financial and technical support to local government in the region including rehabilitation of landfill sites, recycling and reuse of tsunami debris and demolition of damaged structures. For example, UNDP is currently beginning work on the improvement of the disposal area for the Kabupaten Aceh Besar capital in Jantho.
3. The Asian Development Bank (ADB) is providing solid waste management technical assistance for the City of Banda Aceh. This assistance includes the development of a solid waste management plan and disposal area operations plan for Banda Aceh. In late February 2006, ADB also conducted a workshop on the SWM plan and on the development and operation of disposal areas. ADB is also planning to undertake basic solid waste management assessments for more populated and impacted sub-districts or community areas in Aceh Besar and Aceh Jaya.
4. The German government through the Gesellschaft fur Technische Zussamenarbeit (GTZ) is providing assistance in the evaluation and selection of a new disposal site to serve the City of Banda Aceh through its spatial planning program.

5. UNICEF has provided equipment and funding for implementation of solid waste collection services in the City of Banda Aceh and in the heavily populated areas of Aceh Besar (primarily located near the City of Banda Aceh.) UNICEF has provided equipment and funds required to operate the collection system. Operational funding is expected to continue until December, 2006.
6. The Turkish government has provided collection equipment including waste compactor trucks for the City of Banda Aceh.
7. Various international organizations such as CARE, OXFAM, etc. are developing housing projects to rebuild impacted areas or to house displaced people. These projects include necessary infrastructure for water supply, sanitation and solid waste management. (It has been estimated that about 100,000 housing units are being or will be built in Aceh Province as a result of various efforts aimed at reconstruction after the tsunami and earthquake.)

Even with the above activities, there is still a strong need for solid waste management capacity building and technical assistance for the institutions that will remain after donor activity has diminished. USAID/ESP's general approach in focusing on capacity building initiatives fits well with the current deficiencies in solid waste management knowledge and capabilities in the region. Principal opportunities for USAID/ESP to be of assistance in solid waste management include the following:

1. Kabupaten Aceh Besar is awaiting assembly approval of its solid waste agency (Dinas Kebersihan). This agency will need assistance in developing its solid waste program for the Kabupaten. Key elements of this program will be the sustainability of current collection services funded through UNICEF and the development of new disposal areas to serve the district.
2. Many communities in the region are being reconstructed. This reconstruction has included the renewal or development of environmental infrastructure including water supply, sanitation and solid waste management. USAID/ESP should provide assistance to communities in the region for development of effective solid waste management services.
3. Many donor agencies and NGO's are developing new communities for people displaced by the tsunami and earthquake. USAID/ESP could provide assistance in planning solid waste management infrastructure for these new residential areas.

This action plan presents the basis for the recommended integrated solid waste management approach. In addition, it also provides capacity building issues that will need to be addressed in providing assistance to the above entities. This capacity building and technical assistance background information is presented in the annex of this report and is intended both for internal USAID/ESP capacity building as well as for developing appropriate initiatives for providing assistance.

In addition to the work that focused on activities in Aceh Province, project initiatives in Medan were also reviewed. These included a community capacity building project in association with a flood control project being developed by the Japanese government as well as a recycling initiative being undertaken at a community within the city of Medan. Inspection reports are presented in Annex 6 of this action plan.

1. INTRODUCTION AND CURRENT CONDITIONS

Solid waste management is a critical issue in many countries including Indonesia. In many ways, it is one of the most evident environmental issues that people face since litter or randomly dumped solid waste is a highly visible problem that people continually observe in their everyday activities. Because of this visibility, people often identify solid waste management as one of their most critical environmental problems.

Increasing populations in urban locations often create situations where the generation of all forms of solid waste exceeds the capacity to effectively collect and dispose of it. In addition to its aesthetic impact, negative health effects have been tied to improper solid waste management. Small communities and rural areas such as those common to Aceh Besar and Aceh Jaya are not immune to these negative effects. The process of simply dumping, burying or burning solid waste near a residence or commercial area where it is generated creates exposure problems that can affect the long term health of people living or working near these activities. The common practice of throwing solid waste into rivers and streams in Aceh Province does have the result of carrying solid waste away from its generators but with a subsequent impact on water quality and people downstream.

ESP

The Environment Service Program (ESP) is a fifty-eight month program founded by the United States Agency for International Development (USAID) and implemented under the leadership of Development Alternatives, Inc. (DAI). ESP works with government, private sector, NGOs, community groups and other stakeholders to improve the management of water resources and broaden the distribution of safe water to urban dwellers by strengthening watershed management and delivery of key environmental services, including clean water, sanitation and solid waste management in Indonesia. The period of the project is from December 2004 through September 2009. ESP activities are focused on six High Priority Provinces: Aceh, North Sumatra, East Java, West Java and DKI Jakarta. ESP also supports a limited set of activities in four Special Concern Imperative Areas: Balikpapan, Manado, Monokwari and Jayapura.

Unfortunately, developing effective solid waste management programs can be a complex process. It involves many diverse participants who are directly responsible for one or more key functions that determine if overall solid waste management is successful. These participants range from individual residential solid waste generators who make daily decisions about what to do with their solid waste to the various levels of government that may have the responsibility for developing solid waste management programs and infrastructure such as collection and disposal systems. Government action in developing collection, transfer and disposal processes or establishing laws and regulations that affect the manner in which solid waste is handled ultimately require close interaction with solid waste generators. For an overall solid waste management program for Aceh Besar and Aceh Jaya to be successful, all of its participants must be engaged and take responsibility for their actions. (This is the premise for this Action Plan that seeks to define the manner by which the Environmental Services Program (USAID/ESP) can assist in the development of effective solid waste management in the various locales that the program is active).

In a regulatory environment where strict enforcement of existing laws and regulations is not a high priority as is the case in Indonesia, the implementation of effective solid waste management (SWM) is extremely difficult. In such a regulatory environment, meaningful progress can only be achieved by changing people's attitudes and practices or by providing participation incentives such as greater solid waste handling convenience. For example, many residential solid waste generators in Aceh Besar and Aceh Jaya currently burn and/or bury their solid waste on their properties near their residences. This will only change if practices like this are prohibited and this prohibition is enforced or if a more convenient and beneficial means of solid waste collection and disposal is available. Additional influences for changing current practices include: 1) public education concerning the health effects of current onsite practices or 2) peer or social pressure associated with community/village consensus and action on good practices.

Individual solid waste management practices on a person's own property are not solely isolated to that property and can affect neighbors and the community. For example, smoke from burning solid waste on individual properties impacts adjoining properties or people on roadways passing by a location with burning garbage. If individuals or a community recognizes the dangerous health consequences of such practices, there may be sufficient incentive to develop reasonable alternatives to the practice and community peer pressure and leadership imposed to make use of SWM alternatives provided by the community or a larger scale government SWM program. However, developing these alternatives at any level in an affordable manner is difficult.

Experience has shown that success in solid waste management is best achieved when governmental units (national, provincial and local) clearly recognize their mandate and responsibilities while also understanding and utilizing the roles, strengths and contributions of other non-governmental participants. A successful program requires an integration of activities of all its participants including:

1. Local government as represented by its various levels of authority including Kabupaten, Kecamatan and Desa units in Aceh Province.
2. The informal private sector including individuals, small entrepreneurs, and micro-enterprises already working with solid waste materials or having the potential to do so.
3. The formal private sector who can serve as contractors for all or portions of a comprehensive solid waste management program.
4. Community-based-organizations (CBO) normally working for their own welfare
5. NGO's often working in pursuit of more generic, idealistic goals that can include effective solid waste management.
6. Individual solid waste generators themselves who have a very important role in proper solid waste management and in the success of programs developed by any of the above participants.

The development of an effective SWM program where each of these participants is engaged in the proper manner requires that a number of key constraints be overcome including:

1. Financial/budget constraints on all participants,
2. Resistance in accepting the credibility and importance of the other participants including, in particular, a lack of recognition of the importance and legitimacy of the informal sector,
3. Insufficient technical or managerial capacity to develop, operate and sustain effective programs at all participant levels, and
4. The difficulty of applying inappropriate technology to the cooperation and interaction required between the participants.

The basic goal for developing an effective solid waste management program (and of this Action Plan) is the strengthening of technical capacity and the working relationship between all of the relevant participants. To that end, the Action Plan attempts to define how USAID/ESP can help to strengthen technical capacity so as to integrate effective and sustainable solid waste management development and practices involving all of the participants referenced above. Further, the Action Plan also recognizes that there are significant ongoing development dynamics occurring in Aceh Besar and Aceh Jaya as a result of the tsunami and its following reconstruction efforts. New or reconstructed housing and municipal infrastructure is being developed with major outside assistance from donors and NGO's. This provides a good opportunity to develop effective solid waste management programs as part of the overall redevelopment momentum.

1.1. PROJECT AREA AND DEMOGRAPHICS

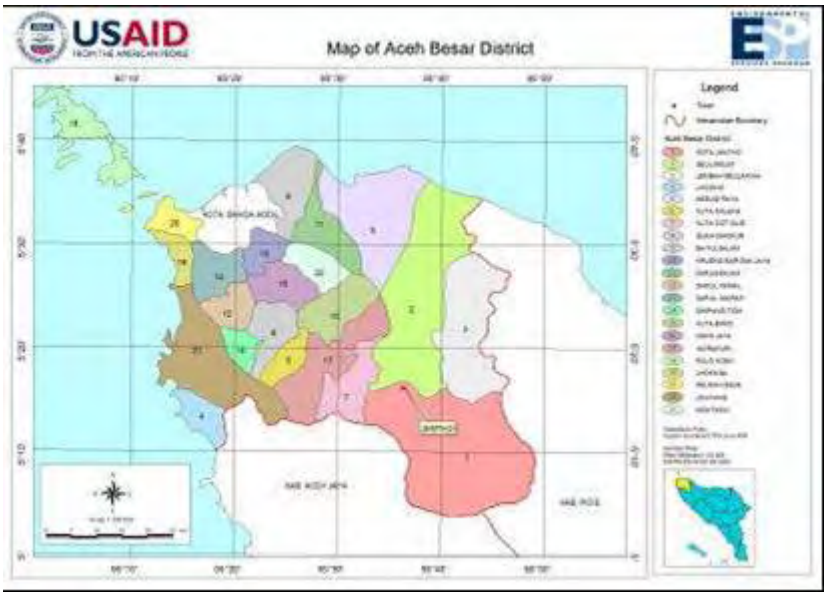


Figure 1 – Map of Aceh Besar District

The focus area for the USAID/ESP program in Aceh Province is in Kabupaten Aceh Besar and Aceh Jaya. Both of these areas are generally rural in character. Aceh Besar (shown in the map below) has a land area of 2,974 square kilometers which is 50% forest land, 20% padang rumbut (grass fields), 12% tanah terbuka (open space). The remainder of the land area (about 38%) is developed. The areas near Banda Aceh (principally Kecamatans Durul Imarah and Krueng Barona Jaya) are the most heavily developed and populated areas of the Kabupaten. In Aceh Besar, there are 22 Kecamatan, 60 Mukim and 601 Desa governmental units. The area and population density in each Kecamatan in Aceh Besar is shown in the following table. Population densities range from 1,141 people per square kilometer in Krueng Barona Jaya to 25 people per square kilometer in Pulo Aceh. (Population density is an important factor in the developing solid waste management programs since high density populated areas are commonly given a higher priority in developing government-based programs).

Table 1 – Aceh Besar Kecamatan Demographics

kecamatan	Ibu Kota	Area km²)	Population 2003)	Density ap/km²
Lhoong	Lhoong	125	11,592	93
Lhoknga	Lhoknga	99	16,556	167
Leupung	Leupung	76	7,878	104
Indrapuri	Indrapuri	299	16,657	56
Kuta Cot Glie	Lampakuk	232	10,756	46
Seulimeum	Seulimeum	487	18,944	39
Jantho	Jantho	274	5,735	21
Lembah Seulawah	Lamtamot	308	7,185	23
Mesjid Raya	Krueng Raya	110	12,277	111
Darussalam	Lambaro Angan	78	16,354	211
Baitussalam	Lambada Lhok	37	18,177	498
Kuta Baro	Peukan Ateuk	92	20,107	218
Montasik	Montasik	130	19,997	154
Ingin Jaya	Ingin Jaya	100	21,466	215
Kreung Barona Jaya	Cot Iri	9	10,337	1,141
Sukamakmur	Sibreth	99	12,137	123
Kuta Malaka	Samahani	44	4,768	110
Simpang Tlga	Kreung Mak	55	5,009	91
Darul Imarah	Lampene Urut	33	34,421	1,045
Darul Kamal	Peukan Bilui	16	5,933	366
Peukan Bada	Peukan Bada	32	19,458	610
Pulo Aceh	Lampuyang	241	6,002	25
		2,974	**301,746**	

Aceh Jaya has a land area of 3,727 square kilometers (60% of which is conservation land). In Aceh Jaya, 60% to 80% of the population lives within 10 kilometers of the coast and along the existing Banda Aceh-Meulaboh Highway which runs the length of the Kabupaten connecting the Ibu Kota of the Kecamatans in Aceh Jaya. There are 6 Kecamatan and 173 Desa in Aceh Jaya as shown on the map on the following page.

Table 2 – Kabupaten Aceh Jaya

Kecamatan	Area (km²)	% of Total Area	Ibu Kota	Desa
Jaya	624	17%	Lamno	48
Sampoiniet	1,011	27%	Lhok Kruet	38
Setia Bakti	629	17%	Lageun	13
Krueng Sabee	588	16%	Calang	18
Panga	307	8%	Keude Parga	19
Teunon	568	15%	Teunom	37
Kabupaten	3,727	100%		173

The earthquake and tsunami of 26 December 2004 significantly impacted Aceh Jaya from the coast line up to 6 kilometers inland. All six Kecamatan in Aceh Jaya were affected with 24% of the population dead or missing, 90 of the 173 villages damaged, 60% of schools damaged, 90% of government offices destroyed and about 24% of the government staff dead. If the conservation land is not considered, population densities in the Kecamatans of Aceh Jaya after the Tsunami and earthquake range from 23 people per square kilometer in Setia Bakti to 72 people per square kilometer in Kecamatan Jaya. The low population density in Aceh Jaya may ultimately focus the development of formal solid waste programs to community level efforts in the smaller population centers in Aceh Jaya.

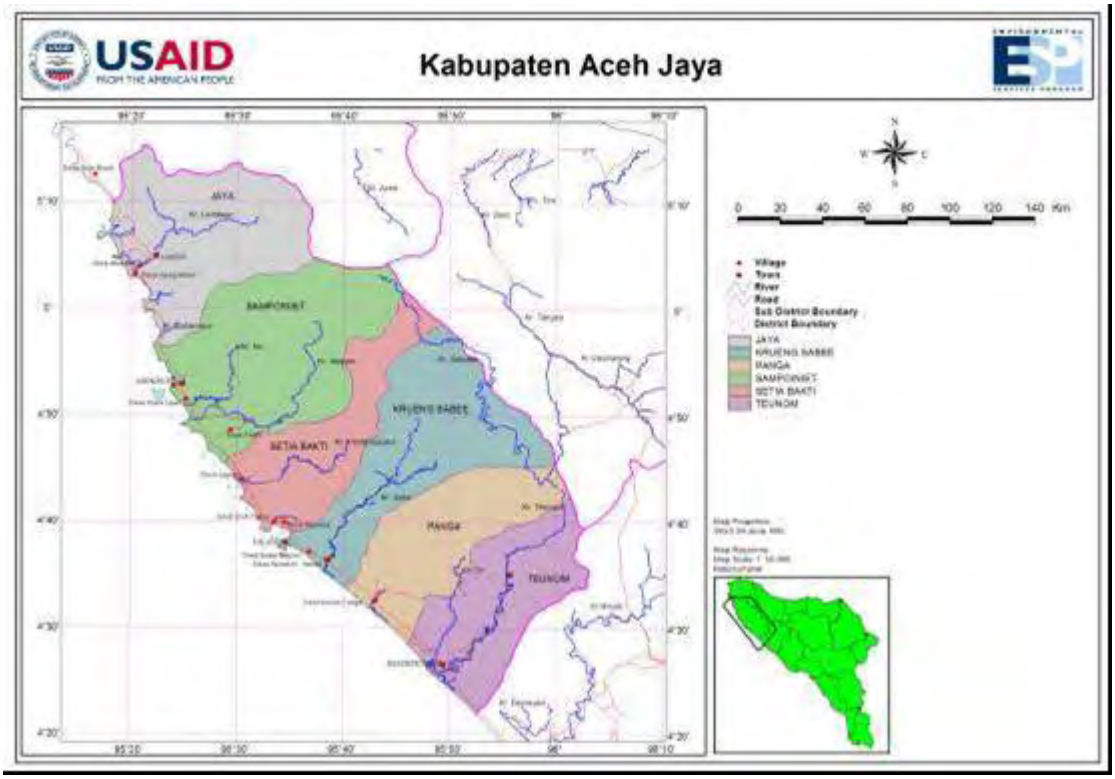


Figure 2 – Map of Aceh Jaya District

1.2. CURRENT SOLID WASTE MANAGEMENT PROCESSES IN ACEH BESAR AND ACEH JAYA

In Aceh Besar and Ach Jaya, each community unit manages their own solid waste while the Kecamatan government may provide some solid waste services for markets and commercial areas. The various solid waste management processes currently utilized in the region range in complexity depending on the nature and size of population served. For example, solid waste management practices in the City of Banda Aceh (City) are different than those used in the Village of Lamkabaue. In Banda Aceh, motorized door-to-door collection and the use of roll-off container-based collection points (TPS) in heavily concentrated residential, commercial or market areas may be a sustainable solid waste collection practice for the

City. The current Gampong Jawa disposal area is classified as an open dump but the amount of solid waste generated in the City and the poor location of the existing disposal area should lead to the eventual development and operation of an improved controlled landfill at a new site (most likely located in Kabupaten Aceh Besar outside of the city).

Table 3 – Current Disposal Practices

Current Disposal Practices		
Disposal Practice	**Kabupaten**	
	Aceh Besar	**Aceh Jaya**
Transported out of the village	4	5
Burned of buried	466	120
Dumped into river or stream	11	20
Other (or no data)	120	28
Total	**601**	**173**

In the population/market centers and rural areas of Aceh Besar and Aceh Jaya (and also many areas of Banda Aceh), a variety of less substantive processes are utilized. Generated solid waste is disposed of through direct burial, accumulation and burning or random dumping on vacanNEt lots or in waterways.

A general summary of the current disposal practices in Aceh Besar and Aceh Jaya villages is shown in the above table. In isolated rural households within each Kabupaten, disposal often occurs near the residence while, in village areas, it may occur at a common site or sites which over time have acquired a solid waste disposal identity as a convenient dumping location.

Traditional markets throughout Aceh Besar and Aceh Jaya are a source of a large amount of solid waste which is commonly transported away from the market area and often randomly dumped. An example of this is roadside dumping locations for the traditional market in Saree which is shown in Figure 1.1. The existing practices shown in the above table create the challenge for those responsible for developing effective SWM alternatives for the region.

1.2.1. PRE – AND POST – TSUNAMI PRACTICES

The tsunami on 26 December, 2004 created widespread destruction throughout the region and the resulting dislocation of many residents and villages in the impacted areas. Eight of the Kecamatan in Aceh Besar and all of the Kecamatan in Aceh Jaya were significantly impacted by the earthquake and tsunami. As a result of the devastation, interior areas of each Kecamatan experienced an influx of displaced people and the establishment of numerous temporary housing areas. In addition, reconstruction of village areas requires a renewal of environmental infrastructure including water supply, sanitation and solid waste management. Similarly, the development of new temporary or permanent housing areas for displaced people has necessitated the development of new support infrastructure which should also include a proper solid waste management system in lieu of renewal of past practices. Logically, SWM management practices in many non-impacted areas of Aceh Besar and Aceh Jaya have not changed. However, the total amount of solid waste generated in the non-impacted areas may have increased because of population relocation to those areas.

The influx of donor and NGO assistance into the region has created a planning momentum in developing and improving environmental infrastructure and programs throughout the region. Currently, there are many donor agencies and 44 different NGOs operating within the 22 Kecamatan of Kabupaten Aceh Besar. Some of their solid waste management development activities include the following:

1. USAID, through the Environmental Services Program, is seeking to provide capacity building and design assistance for water supply, sanitation and solid waste management infrastructure development in the region. (This Action Plan aims at identifying the best way in which to provide that assistance.)
2. The United Nations Development Program (UNDP) Tsunami Recovery Waste Management Program is providing financial and technical support to local government in the region including rehabilitation of landfill sites, recycling and reuse of tsunami debris and demolition of damaged structures. For example, UNDP is currently beginning work on the improvement of the disposal area for the Kabupaten Aceh Besar capital in Jantho.
3. The Asian Development Bank (ADB) is providing solid waste management technical assistance for the City of Banda Aceh. This assistance includes the development of a solid waste management plan and disposal area operations plan for Banda Aceh. In late February 2006, ADB also conducted a workshop on the SWM plan and on the development and operation of disposal areas. ADB is also planning to undertake basic solid waste management assessments for more populated and impacted sub-districts or community areas in Aceh Besar and Aceh Jaya.
4. The German government through the Gesellschaft fur Technische Zussamenarbeit (GTZ) is providing assistance in the evaluation and selection of a new disposal site to serve the City of Banda Aceh through its spatial planning program.
5. UNICEF has provided equipment and funding for implementation of solid waste collection services in the City of Banda Aceh and in the heavily populated areas of Aceh Besar (primarily located near the City of Banda Aceh.) UNICEF has provided equipment and funds required to operate the collection system. Operational funding is expected to continue until December, 2006.
6. The Turkish government has provided collection equipment including waste compactor trucks for the City of Banda Aceh.
7. Various international organizations such as CARE, OXFAM, etc. are developing housing projects to rebuild impacted areas or to house displaced people. These projects include necessary infrastructure for water supply, sanitation and solid waste management. (It has been estimated that about 100,000 housing units are being or will be built in Aceh Province as a result of various efforts aimed at reconstruction after the tsunami and earthquake.)

All of the above activities are important in the development of a more comprehensive and **sustainable** SWM program to serve Aceh Besar and Aceh Jaya.

1.2.2. LEVEL SERVICE OF COVERAGE

The Indonesian Rehabilitation and Reconstruction Agency (BRR) has set target level of service coverage for infrastructure services associated with the reconstruction of settlements in Aceh Province. This includes solid waste management where the proposed level of service is to develop SWM services (excluding disposal) to cover 100% of the urban and 10% of the rural population. The disposal-related target is to construct disposal sites to serve 100% of urban population.

Ultimately, the areas served and the development of new SWM infrastructure for a comprehensive solid waste management program in Aceh Besar and Aceh Jaya will be determined by the availability of budget for the activity. In a meeting with the Pemerintah Kabupaten Aceh Besar Badan Perencanaan Pembargunan Daerah (BAPPEDA), the Bappeda director, Ir. H. Hasballah M. Ali, indicated that, at present, there is no budget allocation for expansion of the formal collection system beyond that which is currently established through use of the UNICEF funding and equipment.

Logically, available solid waste management choices for many solid waste generators in Aceh Besar and Aceh Jaya will change with time as more comprehensive Kabupaten or Kecamatan-based SWM programs and services become available. For example, villages in

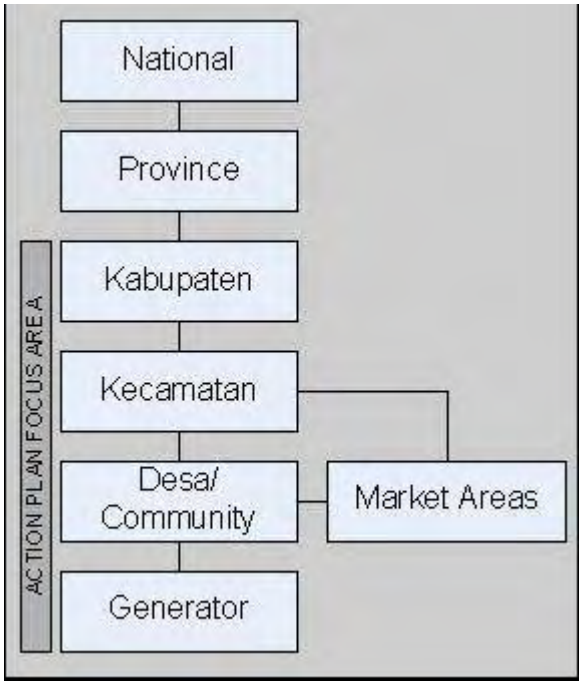


Figure 3 General Institutional Structure

Aceh Besar and Aceh Jaya may eventually have the opportunity to economically transfer their solid waste to new disposal locations (TPA) developed by the government in their region. However, until such facilities are available, the villages and isolated households will need to rely on more local alternatives for disposal such as interim dump sites. The design premise of this Action Plan is that improved solid waste management (with its resulting health benefits) is currently possible at all participant levels through more effective practices (especially those at the household or community/village level) irrespective of whether a government-based transfer and disposal program is available in the near term. This provides the basis for a number of the community level initiatives and recommendations that the ESP program may undertake in fostering effective solid waste management in the region.

1.3. CURRENT INSTITUTIONAL STRUCTURES AND RESPONSIBILITIES

The general administrative structure of government in the region is shown in Figure 3. While overall direction on future solid waste management may be provided by the Kabupatens, each of the subdistricts (Kecamatan) is expected to play a major operational role. Currently, Kecamatans in each Kabupaten provide some SWM services for markets areas. Kabupaten Aceh Besar has 22 Kecamatan within its jurisdiction and Kabupaten Aceh Jaya has 6. Within each Kecamatan, village or Desa governmental structures exist which will also have an important role in future solid waste management.

From a solid waste management standpoint, population estimates are important in determining solid waste management infrastructure needs. For example, initial determination of required disposal capacity for a region can be based on an evaluation of the population served and the solid waste contribution of commercial areas such as markets. Approximate unit solid waste generation rates applicable to the region are shown in Table 4. These can be used to estimate the amount of solid waste that must be managed through any developed SWM infrastructure.

The physical characteristics of each of the sub-districts in Aceh Besar and Aceh Jaya vary and will be important in determining the nature of solid waste management services that will ultimately be provided for generators. For example, a formal government-based collection program may be practical for population centers but not for more isolated rural areas. Development of formal government solid waste management programs will, most likely, follow the general pace and direction of development in the region. For example, pre-tsunami development planning (BAPPEDA Kabupaten Aceh Besar - Revised Master/Spatial Plan (Revisi Rencana Tata Ruang Wilayah)) established a general development priority for the population centers in Aceh Besar as shown in the table below. The priority order shown in the table may have been somewhat altered since Lhoknga, Peuken Bada, and Lampuyang were heavily damaged by the tsunami and earthquake.

Table 4 – Unit Solid Waste Generation Rates

SOURCE	QUANTITY	UNITS
Residential House	2.2	Liter (L) per person per day
Market	0.2	L/ square meter (m^2)
Commercial	2.5	Liters per employee/ day
School	0.1	L/ student/ day
Roads	0.1	L/ lineal meter/ day

Neither Kabupaten Aceh Besar nor Aceh Jaya has a formal solid waste management agency (Dinas Kebersihan) although approval for such an agency for Aceh Besar was submitted to the District Assembly (Kabupaten Dewan Perwakilan Rakyat Daerah) in October 2005.

Table 5 – Aceh Besar District Development Priorities

ORDER	CITY NAME
Capital	Jantho
I	Indrapuri, Lamboro and Lamperunereut (Darul Imarah)
II	Seulimeum, Sibreh (Suka Makmur and Lhoknga
III	Peukan Ateuk, Peukan Bada, Lambaro Angan and Montasik
IV	Krueng Raya, Lampuyang, Lhoong and Peukan Bilui

Once approved, this agency is expected to take the lead in planning and implementing a comprehensive solid waste management program for the Kabupaten. Currently, through funding and equipment provided by UNICEF, a solid waste collection system for the more urbanized and heavily populated areas in proximity to the City of Banda Aceh as well as in the Kabupaten capital, Jantho, is in operation. Collected solid waste from the area near Banda Aceh is transported to the current Gampong Jawa disposal area which is located near Krueng Aceh. Solid waste collected in Jantho is transported to an open dump on the outskirts of the city. This collection program is temporarily under the direct supervision of the general manager of the Aceh Besar water utility, Perusahan Daerah Air Minum (PDAM). Upon the commencement of SWM activities by the Dinas Kebersihan, the agency will take over the collection equipment and service provided by the UNICEF support. In addition, the new agency is expected to provide more focused planning for SWM in Aceh Besar. Currently, the BAPPEDA for Aceh Besar developed the Usulan Program Pembangunan Infrastruktur Tahun 2006 – 2010/2011 (prepared in November 2005). This document presents information on plans and budget for water, sanitation, solid waste, and drainage in each Kecamatan. The budget allocates almost equal quantities money to each Kecamatan for sanitation, drainage, and solid waste but does not provide details concerning the manner in which the budget is to be spent. The new agency may provide greater focus on SWM needs for the region. The creation of this agency may also provide an excellent opportunity for USAID/ESP to be of assistance in helping the agency build its technical and managerial capacity.

1.4. HEALTH EFFECTS OF IMPROPER SOLID WASTE MANAGEMENT

The health consequences of improper solid waste management are significant. Unfortunately, there is often no clear linkage between a cause (improper solid waste management, for example) and an effect (such as a disease related to improperly managed solid waste). In addition, people don't always have a clear understanding of the dangers associated with random dumping or burning of solid waste. The creation of public knowledge and a linkage between current SWM practices and undesirable health effects is one of the most important elements of the public education process necessary for implementation of an effective solid waste management program. Helping to increase public awareness of the health effects of improper solid waste management can be another important role for USAID/ESP in the future.

Health risks from improper SWM are caused by many factors, including:

1. The nature of the solid waste material itself including its composition which may be comprised of toxic and infectious substances;
2. The nature of waste as it decomposes (such as the creation of gas and leachate at disposal sites) and the change in ability to cause negative health effects in receptors;
3. The handling of waste (such as the exposure to danger that solid waste workers and waste pickers have in improperly handling the material);
4. The process of disposal (which can cause odor, noise, instability of waste piles, air and water emissions, groundwater and surface water contamination, fires, etc.).

Organic waste from households, restaurants, and market areas attracts rats which are potential hosts for many infectious diseases. Organic waste also serves as food and a habitat for domestic flies which can transmit fecal-oral infections. Other vectors found in solid waste accumulations including randomly dumped materials along roadways or in waterways include mosquitoes and sand flies. Solid waste accumulations often include materials such as metal containers, jars, and tires that can collect rainwater. Aedes mosquitoes (which transmit filariasis, urban yellow fever, dengue fever, and several other arboviral infections) can breed in these water-filled containments. Poorly managed solid waste often ends up in drainage systems. This can block drainage channels and pipes resulting in the ponding of water. As these surface waters are often polluted with organic waste, breeding sites for Culex mosquitoes and domestic flies are created.

In addition to the above direct contact health effects, improper solid waste practices can have other major effects. For example, leachate from improperly sited or operated disposal sites can pollute surface and groundwater. The can be a significant danger for people who use this water for various purposes including as a source of potable water.

Burning waste at a small scale near a residence or at a larger scale at disposal areas or unofficial dumps causes the release of dangerous substances to the air which can impact people in proximity to the burning waste. This can have a significant negative effect on the health of people working at disposal areas or waste pickers who may have set the fires in the first place to reduce vectors or odors. Typically, airborne contaminants such as particulate material and trace organic compounds such as dioxin can travel long distances to impact the air that people breathe in residences or other critical locations such as schools.

Specific waste streams with uniquely dangerous properties such as medical waste or hazardous waste can be very dangerous to people who come into contact with or improperly handle them. For example, waste pickers who come into contact with these materials may not be knowledgeable of their dangerous properties. Typically, waste pickers (or disposal area operators, for that matter) may not have or use personal protective equipment such as boots and gloves that would otherwise protect them.

Clearly, effective solid waste management programs will reduce the health impact of current practices in addition to improving general aesthetic conditions throughout the region. This provides the justification for the extensive effort required to implement an effective SWM program. Many of the processes and facilities that comprise an effective SWM program are aimed at mitigating the potential health effects of improper solid waste management. The public education component of the program must also focus on making people aware of the dangers involved so as to help in motivating their altered attitudes about what they do with the solid waste that they generate.

2. BASIC OF INTEGRATED SOLID WASTE MANAGEMENT

This Action Plan recommends that any solid waste management program developed in the region be formulated under the principles of Integrated Solid Waste Management (ISWM).

2.1. THE INTEGRATED SOLID WASTE MANAGEMENT PROCESS

Effective solid waste management requires the integration of a number of diverse processes that are all important to the overall effectiveness of the program. These general processes are illustrated in Figure 2.1 which presents a model schematic for Integrated Solid Waste Management. The model recognizes that the process flow path consists of key processes including waste generation, primary and secondary collection and disposal. In addition, waste reduction, reuse and recycling (the 3Rs) are inherent to all of the line processes and are a very important element of the ISWM approach.

The ISWM model recognizes that each of the processes is important in the success of the overall program. It further recognizes that the participants responsible for individual elements of the processes must work closely together in an integrated manner to achieve the overall desired result of environmentally sound and cost effective solid waste management. Effective ISWM (or any environmental management, for that matter) requires leadership, discipline and sufficient resources for success by these participants. For any specific location such as Aceh Besar and Aceh Jaya, there are a number of considerations that also influence the manner in which the ISWM approach should be developed and utilized. These are also illustrated in the Figure 2.1 model schematic.

This Action Plan recommends that USAID/ESP seeks to promote the ISWM approach by addressing the potential roles and responsibilities for all of the **participants** and attempting to identify the key **considerations** that must be addressed if the required **processes** are to be developed in a manner that is effective and sustainable in Aceh Besar and Aceh Jaya.

It is important to note that the general features and premise of the ISWM model are applicable to development of solid waste programs at all participant levels. For example, the model schematic, as shown, is directly applicable to developing a Kabupaten-level program which should encompass all of the participants shown in the schematic. This should form the basis for recommended activities that the Dinas Kapersihan takes on as it assumes its responsibility for solid waste management in Kabupaten Aceh Besar.

Similarly, developing a ISWM program at the community level must also address the same considerations although the list of participants may be reduced and some of the processes (secondary collection and transfer, for example) may not be initially necessary until the

community program integrates with the Kabupaten or Kecamatan programs as they are developed. However, the recommended ISWM program approach is applicable to community based programs. This should form the basis for assistance to be provided by USAID/ESP at the community level and particularly in the program focus communities.

The Action Plan assumes that development of effective ISWM processes at the community-level may initially lead to some SWM program autonomy where each community is managing all aspects of their own programs with no available interface to a government-based program. The development of community level interim disposal areas, for example, may be necessary until such time as a government TPA becomes available for the region. This assumes that the means, leadership and interest exists in each community to develop better solid waste management without waiting for the government based facilities to become available. In the case where new infrastructure is being developed for new housing, the program elements of this Action Plan can be utilized to help implement effective solid waste management processes to serve the area once populated.

At both the government and community level, there are key considerations that need to be factored into the development of an effective ISWM program. These include the following:

2.1.1. ENVIRONMENTAL CONSIDERATIONS

The effort associated with implementing an ISWM program is justified by the environmental and health benefits that will derived from an effective program. Many current practices such as random dumping or substandard disposal areas that may be in poor locations have a negative environmental impact. Effective ISWM processes take environmental and health impact into consideration in development and design. This is particularly the case in locating and constructing new disposal areas. Environmental considerations of ISWM processes must also be considered in development of community-level programs. Interim disposal areas must also be sited and operated with environmental impact in mind.

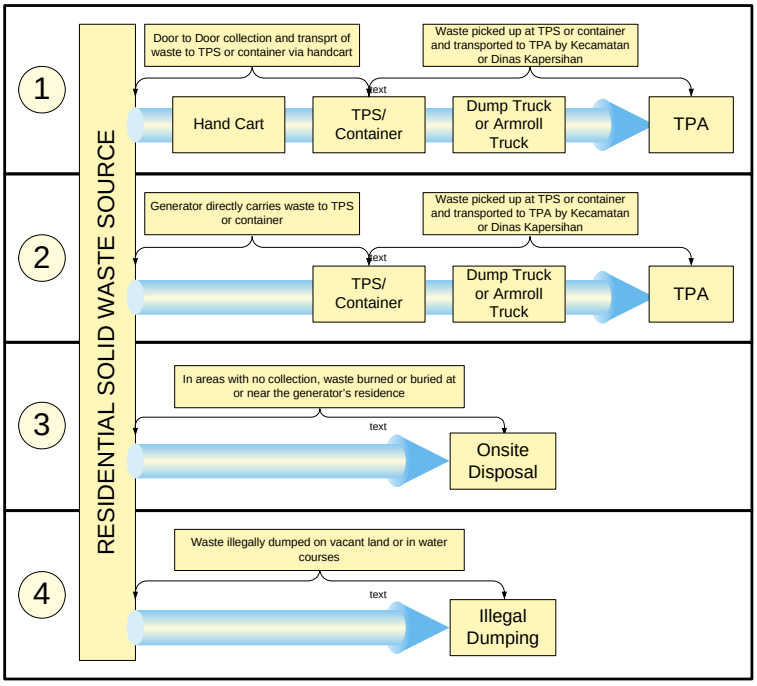


Figure 4 – Residential Solid Waste Collection Alternatives

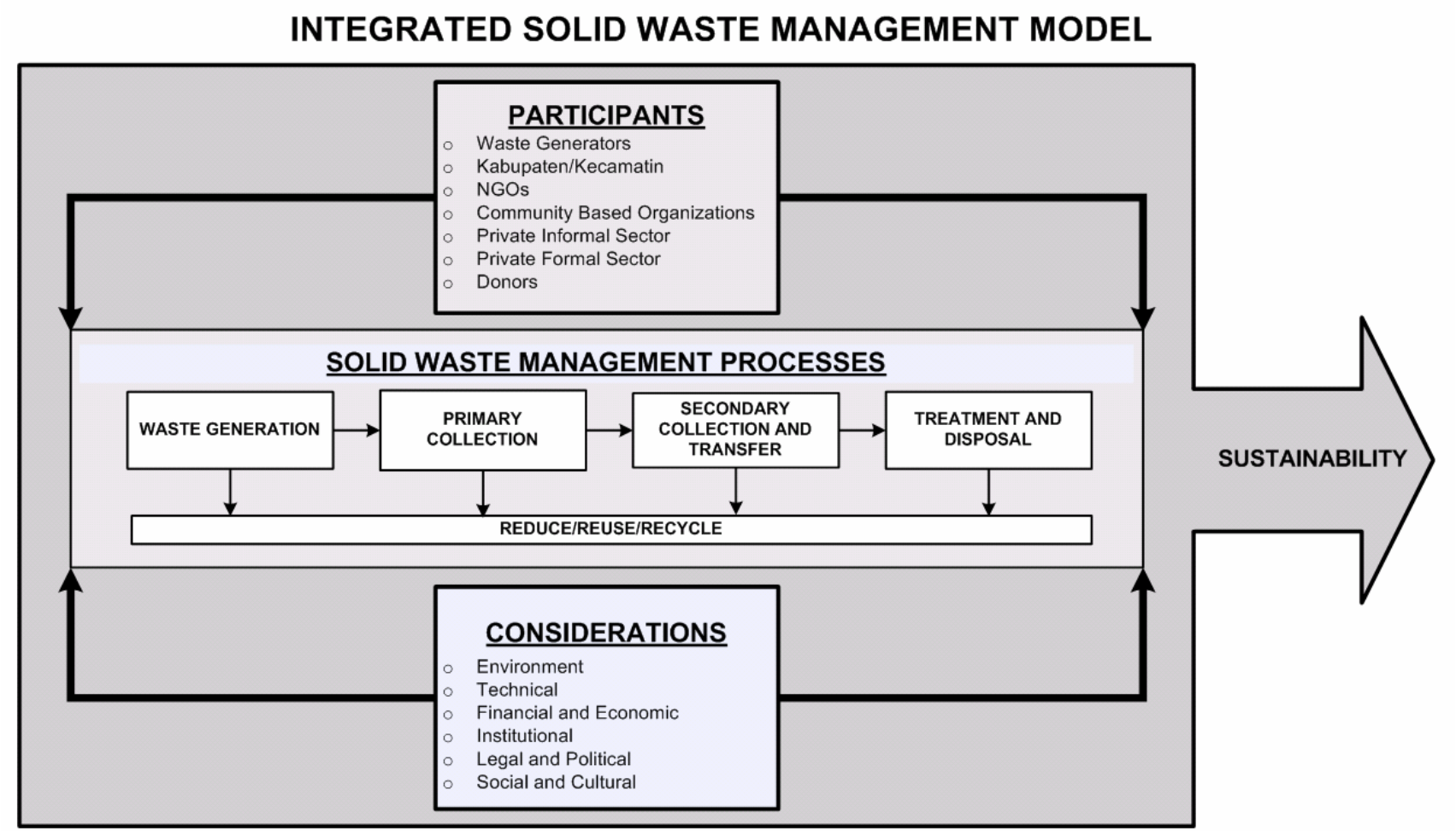


Figure 5 –Integrated Solid Waste Management Model

2.1.2. TECHNICAL CONSIDERATIONS

There are a number of alternative approaches that can be utilized in each of the ISWM processes illustrated in model schematic. The following schematic shows the technical alternatives by which residential solid waste generators can manage their solid waste. The schematic reflects both current practice as well as those that could exist after the development of community and government programs.

Experience throughout the world has shown that some technologies and practices may not be applicable and sustainable in all applications. For example, technologies that may be applicable to solid waste management in a city like Jakarta or even Banda Aceh most likely will not be applicable to small population centers and rural areas such as those found in Aceh Besar and Aceh Jaya. The ISWM approach requires that systems and practices be adopted that are effective **and** sustainable in the area for which they are developed. Annex 1 of this Action Plan presents a summary of **sustainable best practices** that may be applicable to solid waste management in Aceh Besar and Aceh Jaya.

2.1.3. FINANCIAL/ ECONOMICAL CONSIDERATIONS

One of the most important issues associated with any successful SWM program is its affordability and the ability to derive sufficient revenues or funds for its sustained operation and maintenance. To the degree possible, the development of user fees for solid waste management services should be considered. However, user fees are a function of the ability (and willingness) to pay for a service as well as the need to relate sufficient or increasing user fees to good quality service. There are costs involved in each process of an ISWM program at either the government or community level. These costs need to be borne by either a waste generator as a direct charge for service or through budget allocations for a government service. A successful ISWM program requires that all costs associated with solid waste management are completely and accurately defined. As a result, full cost accounting at the government and community level is very important and provides a focus point for assistance that may be provided by USAID/ESP.

Development of an effective ISWM program requires that the people responsible for its development understand the common impediments that exist for securing sufficient funds to sustain their desired program. Local governments and community based organizations in many countries often do not have a dedicated income source for solid waste management services. Their sources of funding often come either from a national government or from services charges (that are often combined with charges for other items such as water or electricity.) Unfortunately, there are often problems with all of these when applying them to solid waste management including the following:

1. People are usually willing to pay for water and other services that they consider essential to their survival. Unfortunately, they often do not have that same attitude about solid waste management. They may seek illegal or informal disposal as an alternative to paying for waste removal especially in a regulatory environment where there is little enforcement of litter laws.
2. Even if residential or commercial waste generators are willing to pay for solid waste services, local government or community leaders are not likely to know what their full costs are so that the actual fees often do not fully cover actual costs.

3. When solid waste fees are based on property assessment such as charging the same amount per resident or commercial establishment, there is no linkage between the amount of solid waste generated and the amount paid. This ultimately eliminates any incentive to reduce the quantity of solid waste introduced into the SWM system.
4. Solid waste programs must often compete with other high priority programs (water, supply, education, etc.) for limited budget allocations. This can lead to insufficient funds for key program elements such as preventative maintenance.
5. Political leaders who make budget decisions often do not understand the need for solid waste management program elements critical for effectiveness and sustainability. Again, allocating money for preventative maintenance is a good example of this.
6. The structure of donor financing or support often makes it easier to secure financing for capital expenditures rather than for ongoing operations and maintenance which help to sustain the program.

A key consideration in the financial and economic development of an ISWM program is the need and ability to periodically replace equipment as it becomes unusable and beyond repair. Each of the entities responsible for a process element (collection, disposal, etc.) needs to provide good fiscal planning to assure that sufficient resources will be available to make necessary replacements as time will require. If this is not done, service deterioration will occur with the ultimate result that solid waste management will devolve to its current substandard practices. From a capacity building perspective, this requires that those responsible for managing a program element which uses equipment or technical infrastructure such as containers, etc. must be aware of the need for full cost accounting and fiscal planning for system upgrades and expansion. This is particularly critical if any SWM improvements resulting from current donor contributions (such as the equipment and operational funding provided by UNICEF) are to be sustained in the future. An effective ISWM program must include a recognition that fiscal and human resources directed to activities such as preventative maintenance will, in the long-term, save considerable money by extending the effective life of equipment and increasing its overall performance efficiency and availability. Failure to do this will result in service deterioration. (This provides another significant opportunity for assistance from USAID/ESP in its focus area.)

2.1.4. INSTITUTIONAL CONSIDERATIONS

The implementation of an effective ISWM approach requires the active involvement of all stakeholders and participants. Currently, many spatial and infrastructure planning activities in Aceh Province are being undertaken by donors and NGO's. Ultimately, the SWM responsibility will fall totally onto the institutions that remain after current donor and NGO programs have lapsed. Accordingly, capacity building elements associated with the institutional considerations of this Action Plan must be aimed at addressing the sustainability of the development process by increasing the knowledge and technical capacity of the institutions that will remain in the long-term. Assistance that USAID/ESP could provide to the Aceh Besar Dinas Kebersihan as it begins its duties is a good example.

2.1.5. LEGAL/ POLITICAL CONSIDERATIONS

National law and governmental decrees establish the roles and responsibilities of the various levels of government in Indonesia. Legally, Indonesian law establishes some of the basis by which effective solid waste management must be practiced. For successful integration, each

of the governmental agencies responsible for developing and operating ISWM processes and elements will need to work in a coordinated manner that best achieves the overall desired result. The manner in which they do so is often set in law or legal precedence.

In addition, key elements of the ISWM program will require significant community and political input. For example, the development of new disposal areas is something that everybody clearly recognizes as necessary. However, once specific sites are identified, there is usually opposition to those sites. The NIMBY (Not in My Back Yard) phenomenon is not unique to Indonesia and requires political will and consensus building to overcome it. An important element of the implementation of an effective ISWM program is the building of political and public consensus required for achieving ISWM elements (particularly transfer stations and disposal areas.)

2.1.6. SOCIAL AND CULTURAL CONSIDERATIONS

A successful ISWM program at both the Kabupaten and community level requires the engagement and contribution of all participants. Since this involves just about everybody as either a waste generator or an active process participant, the cultural and social aspects of the region must be considered. This includes the manner in which individual waste generator practices can be influenced as well as the means for achieving community results through collective efforts.

2.2. IMPLEMENTATION OF INTEGRATED SOLID WASTE MANAGEMENT THROUGH CONVERGING PROGRESS

The Converging Progress principle recognizes that good solid waste management choices for individual generators are influenced by the processes that are developed through community or government SWM programs and, therefore, available to them. Accordingly, any progress that can be achieved in getting solid waste generators to change their individual practices eventually converge with the progress made in developing community or governmental level programs. For this reason, public education is warranted throughout the development process even though larger scale SWM infrastructure at the community or governmental level may not yet be available. Simple steps that individual generators can take to alter their current practices and protect themselves and their families can have health and aesthetic benefits even before formal collection programs becomes available. This provides some basis for undertaking elements of public education early in the process of developing an ISWM program.

Similarly, community-level ISWM programs can be developed that do not require the availability of a government system such as secondary collection and transfer program or regional disposal areas. This may lead to the development of interim disposal locations for placement of solid waste collected in the community. Community leaders should recognize

that environmental benefits can be achieved by autonomous community-based programs that solely address the solid waste generated in the community. Community leaders should plan these programs so that they can eventually integrate with a government program when and if it becomes available. An example of this eventual integration is the conversion of an interim disposal location into a transfer facility once transfer to a government-sponsored TPA become practical.

The reality of SWM in rural areas such as significant portions of Aceh Besar and Aceh Jaya is that not all of the solid waste generated will be collected and disposed of in government or even community based programs. In generally rural areas, sustainable best practice may mean that specific areas where there are concentrations of waste generation sources (population centers such as villages, markets, housing projects, etc.) should be addressed

first since a large proportion of the solid waste generated in the region is derived from those locations. At the same time, efforts should be made to identify and plan for the management of solid waste streams with unique properties such as medical waste from hospitals and clinics. Similarly, working to divert portion of the waste streams with characteristics compatible with beneficial use applications should be begun immediately as well. An example of this is the independent management of organic waste from market areas which may provide a good source of material for a small scale composting process.

The ultimate performance target should be to collect as much of the solid waste generated in the Kabupaten and dispose of it in a safe, environmentally sound and cost effective manner. However, the reality of an achievable target is that considerably less than 100% of the solid waste generated will be collected given the rural nature of much of Aceh Besar and Aceh Jaya. Much can be achieved by implementing programs that are affordable to directly manage as much of the solid waste that is within practical reach. To that end, an overall ISWM program that encompasses all participants is warranted including attempts to educate remote solid waste generators that will, most likely, never be part of a government or community program.

In recognition that all of the participants must be engaged to achieve progress, the Action Plan recommends USAID/ESP capacity building and institutional development initiaitives that are not limited to any one level of responsibility. In addition, the Action Plan recognizes that ultimate progress throughout Aceh Besar and Aceh Jaya will be function of individual progress at all levels. As a result, the recommended program development steps include elements that take advantage of the current site specific SWM situation which is influenced by:

1. The development of new housing area where new infrastructure is being developed. These provide an opportunity for USAID/ESP to help establish good (hopefully, sustainable) practices as these areas are activated.
2. UNICEF support for collection services in a portion of Aceh Besar. This has provided funds and equipment for a limited collection service that covers the urban areas of Aceh Besar in proximity to Banda Aceh. While UNICEF support is expected to lapse in December 2006, USAID/ESP assistance is warranted to make this program sustainable and to expand it into other area of the Kabupaten.
3. Spatial planning support currently underway provides a basis for integrating SWM practices at the community level within the concept of spatial development. This requires that various institutions and government agencies understand and accept their responsibility for ISWM functions as planning occurs. USAID/ESP can help in providing information that will allow these institutions and governmental units to build their technical capacity to achieve the desires result.

3. ISWM PROGRAM IMPLEMENTATION

There are currently solid waste management issues at all levels of responsibility in Aceh Besar and Aceh Jaya. In addition, new institutions and housing areas are being developed that will influence the manner in which solid waste is managed. The sponsorship of USAID/ESP capacity building elements as presented in the Annex of this action plan should be a function of a plan to evolve solid waste management from its current state to an effective integrated program addressing each level of responsibility for solid waste issues. Solid waste management will, most likely, evolve at its various levels of responsibility. This should provide the basis by which USAID/ESP applies its efforts by helping to address issues at both the government and community level.

3.1. DEVELOPMENT STEPS FOR A GOVERNMENT-LEVEL ISWM PROGRAM

Aceh Besar is currently awaiting final approval of its Dinas Kapersihan to manage solid waste within the Kabupaten. Once approved, the agency will need to begin addressing many issues associated with implementing an effective SWM program. These issues will include the incorporation of existing initiatives such as the current urban area collection program supported by UNICEF. Figure 2.2 illustrates the development steps by which the Dinas Kapersihan can implement an effective ISWM program. These steps include the following:

Decision to Institutionalize Solid Waste Management – The process of creating a SWM structure in Kabupaten Aceh Besar begins with a decision to do so. Kabupaten Aceh Besar has already done that through seeking formal approval for its Dinas Kebersihan. Additionally, some Kecamatan in Aceh Besar have assumed responsibility for some solid waste management functions such as the collection of solid waste from market areas. At the community level, infrastructure development for new housing areas has included solid waste management elements. Planning for these areas, therefore, inherently seeks to develop a community-based approach that institutionalizes the issue at that level.

Define Target Level of Service – The decision to institutionalize SWM should then lead to the definition of target levels of service. Performance targets may have been set by external entities such as the BRR target of providing SWM served to 100% of the urban population and 10% of the rural. However, more realistic targets will, most likely, evolve from budgetary constraints available to the implementing entity.

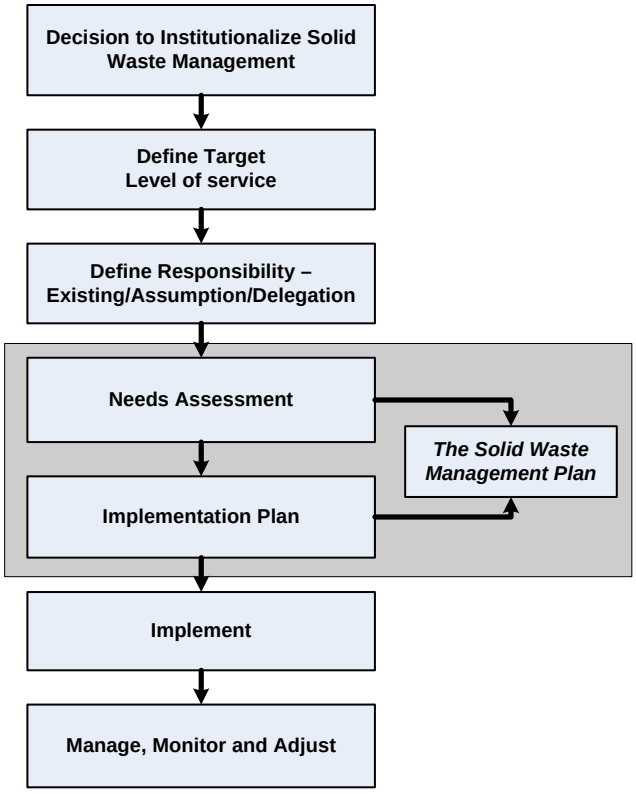


Figure 6 – Integrated Solid Waste Management Development Process

Define Responsibility – **Existing/Assumption/Delegation** – If the ISWM approach is adopted, the Kabupaten must consider how all of the necessary SWM processes are to be developed and managed. In the case of a fully integrated program, individual processes will be undertaken by various participants. The Kabupaten should undertake overall planning for the ISWM program. This should include work, in conjunction with the Kecamatan, on establishing new disposal areas and transfer locations in the district. In addition, the responsibility for developing and operating the secondary collection program will also need to be defined. Planning and design assistance could be provided to the Kecamatan by the Kabupaten.

In primary collection and secondary collection transfer, the responsibility for the solid waste being managed transfers from participant to participant as the material works its way through the system processes. This is illustrated in the schematic below where the responsibility for the solid waste collected transfers at the interface between the primary and secondary collection processes. The manner in which this responsibility is borne by each participant will determine the success of the SWM program.

Needs Assessment – The needs assessment provides the definition of technical resources (vehicles, collection points, etc.) that will be required to achieve the target level of service established for the program. This needs assessment must be specific to the characteristics of the service area so as to define the technical resources required based on actual conditions. The solid waste management plan undertaken by ADB on behalf of the city of Banda Aceh is an example of a needs assessment that defines service area requirements for the city.

Implementation Plan - The implementation plan for developing the ISWM program is normally combined with a needs assessment and form the the solid waste management master plan. This provides the anticipated schedule, sequence, and steps to be taken in developing the program. In most cases, an experienced consultant is hired to complete the solid waste management plan. However, this plan is only one step of the process of developing the ISWM program as represented in the implementation schematic of the previous page.

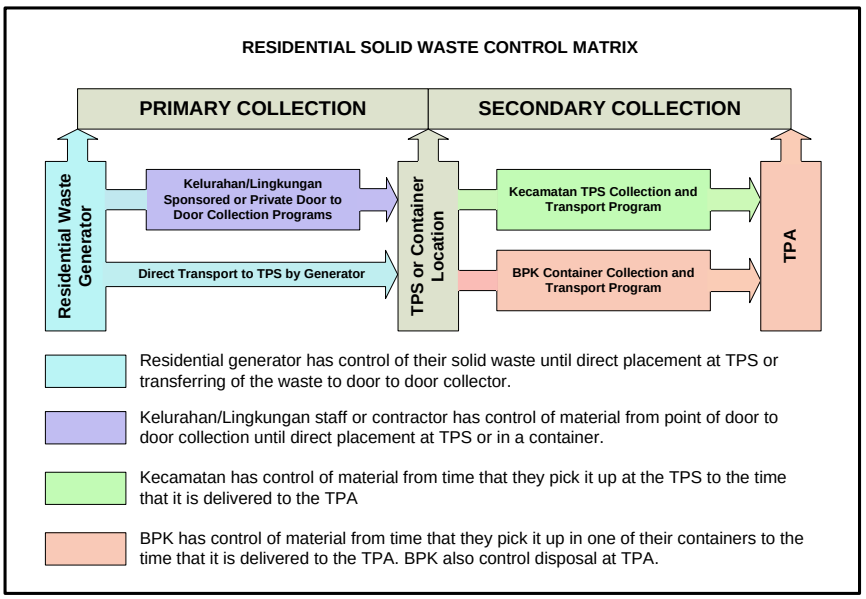


Figure 7 – Solid Waste Management Responsibility Matrix

Implement - Once the overall program elements have been defined, implementation can begin. In many cases, implementation of some components of the overall program will take longer than others. For example, the process to develop new disposal areas is often lengthy and requires considerable effort. At the same time, the secondary collection program can be developed that provides an expanded means for collecting solid waste and transporting it to the existing disposal area. The intent of the solid waste management master plan comprised of the previous two steps is to provide a roadmap by which the system can be developed and put into service. This allows the people responsible for implementing the program to understand the technical and financial resources required to implement the system.

Manage, Monitor and Adjust - Once elements of the ISWM program are in place, they need to be managed and operated in accordance to their design intent. As conditions evolve in the region, program adjustments must be made. For example the location of new disposal areas may ultimately affect the manner in which a solid waste is collected. Collection vehicles that are on a prescribed route based on travel time to the existing disposal area at Gampong Jawa may operate differently once a new disposal area are is developed in closer proximity to or further away from the collection route. Continual adjustments will be required as the integrated solid waste management program evolves.

It will also be the responsibility for any participant managing a program element to closely monitor their area of responsibility so as to maintain the desired level of efficiency. Front-line managers and supervisors will need to closely watch the performance of various SWM functions to assure that they maintained their desired level of performance.

So as to assist in providing the knowledge required to accomplish the above development tasks, subsequent chapters of this action plan attempt to define best practice in activities aimed at developing and optimizing each of the basic processes in the ISWM model. People responsible for developing a solid waste management program at the Kabupaten or community level need to understand the issues that are involved in their activities. The following presents those elements which are critical to building technical capacity in government staff or community people who will have a role in particular processes in the program.

3.2. DEVELOPMENT STEPS FOR A COMMUNITY-LEVEL ISWM PROGRAM

In a general sense, the development steps associated with the development of a community-level ISWM program are similar to those used in developing a government program. There are two general scenarios under which a community-based system is developed. In the first, the community-based system is designed to interface with the government's secondary collection and transfer program. In the second, the community may be developing its own autonomous system that will provide management of its solid waste without an interface with a government based system. In the former, the government based system design may have determined the location and technical configuration of collection points. This may include the location of fixed TPS or locations where containers would be placed for receipt of solid waste. The community must then decide on the manner in which generated solid waste will be delivered to the collection points. The alternative ways by which solid waste may be delivered to the collection points includes:

1. Direct delivery to the collection points by the solid waste generators,
2. Cart collection programs that operate as an independent business providing a service to waste generators
3. Community sponsored cart-based collection programs that are managed and monitored by the community.

If a government based secondary collection and transfer program is not available, community leaders may still decide to develop a solid waste management program. In this instance, the community may decide on specific locations for waste collection points. A smaller scale needs assessment analysis would be required to determine infrastructure requirements for the community-based system. This would include determining the location and number of waste collection points or, as an alternative, the requirements to operate a cart-based collection program within the community. Once these technical requirements have been defined, their cost can be determined and the community must find a means for covering those costs. Once the systems are in place, community leaders must closely monitor the performance of the system including the anticipation and performance of waste generators in fulfilling their responsibilities for proper solid waste management.

If an autonomous community-based system is to be developed, community leaders may need to determine interim disposal locations for collected solid waste. To the degree possible, interim disposal locations should be selected with some of the same basic considerations as would be the case for a large a scale regional disposal area. In selecting location for interim

disposal areas, community leaders should also keep in mind that these areas may then ultimately become transfer locations once a government based secondary collection and transfer system is in place.

3.3. USAID/ ESP ACTION PLAN CAPACITY BUILDING ELEMENTS

In creating an effective ISWM program, a base line level of understanding is required of all the participants. Experience has shown that there are a number of common subjects where technical capacity is required. This Action Plan attempts to provide a basic level of understanding of key issues so that USAID/ESP can define its solid waste management initiatives and the manner in which capacity building and technical assistance can be provided. To this end, various ISWM program participants must understand the following in terms of each of the key ISWM processes. These generally provide the basis by which USAID/ESP should seek to provide its assistance to ISWM participants at the government and community-level. Key points associated with the principal capacity building element are presented in the Annex of this Action Plan.

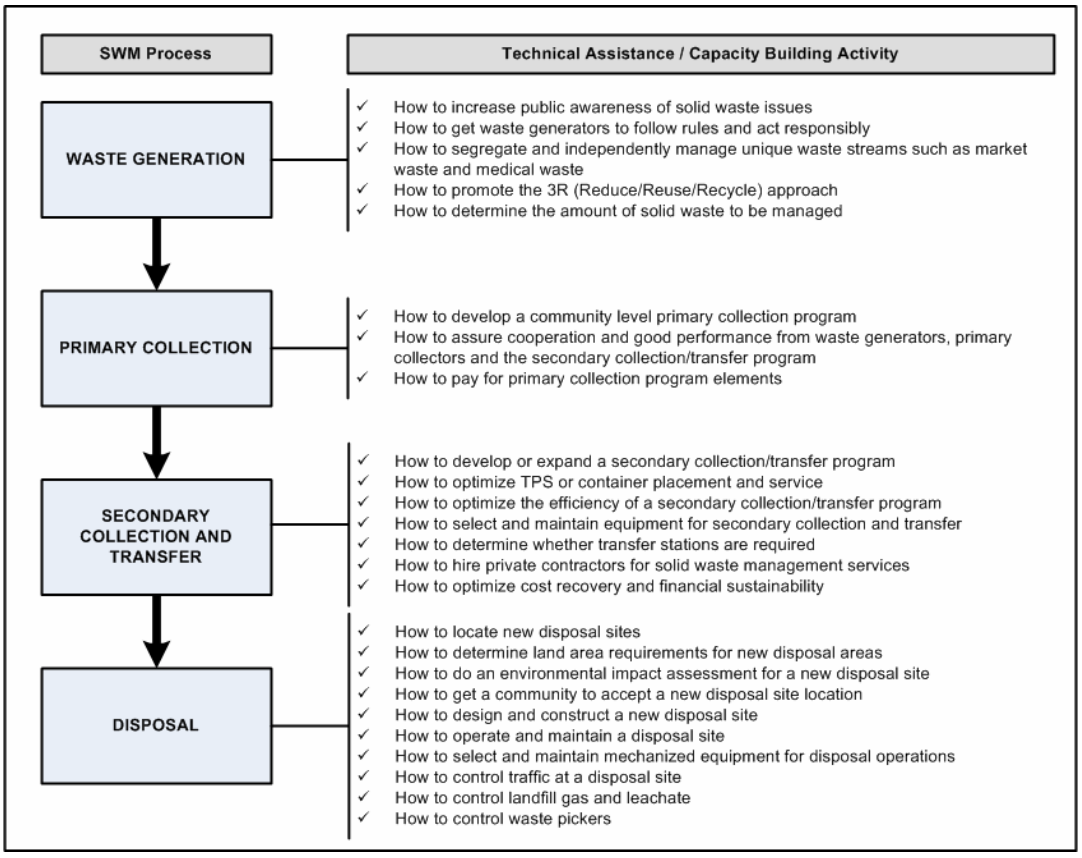


Figure 8 – ISWM Technical Assistance and Capacity Building Elements

4. RECOMMENDED ESP SOLID WASTE MANAGEMENT INITIATIVES

In organizing its solid waste management initiatives, the USAID/ESP program should seek to develop activities that are complimentary to the SWM work undertaken by other organizations in the region. At a minimum, these activities should include the following:

1. Development of a comprehensive public awareness program aimed at individual residential and commercial solid waste generators. The primary focus of this public awareness program should be the health impact of improper solid waste management. This is consistent with the health based objectives of the USAID/ESP program.
2. Capacity building and technical assistance for the new Kabupaten Aceh Besar Dinas Kebersihan as they begin to organize their solid waste management activities.
3. Capacity building and technical assistance to individual community organizations. Initially, this assistance should be provided to communities in which USAID/ESP is involved in other activities such as the development of water and sanitation services
4. Technical assistance to development organizations such as CARE to establish effective solid waste management programs in new or reconstructed housing areas as they are being developed.

Various information concerning the capacity building assistance that may be provided to the above entities is shown in the Annex of this Action Plan. However, it is important that the assistance that USAID/ESP provides to any of the above be provided within the context of the integrated solid waste management approach.

The following are key steps that should be taken by USAID/ESP in implementing its solid waste management activities and initiatives.

1 Assign or hire an individual who will have solid waste management as a primary function in the USAID/ESP Banda Aceh office. This individual should have sufficient background on solid waste management issues to provide capacity building technical assistance at both the government and community level.

2 Reorient and translate sections of the various annex to this report to serve as a community level ISWM development primer or as a manual for the workshops recommended below.

3 Develop general public educational materials on health issues associated with improper solid waste management and on the development of community level solid waste management programs.

4 Develop general educational materials aimed at school age children concerning the need for effective solid waste management programs. (Materials previously presented from United States EPA sources can be used as a template for design of these materials.)

5 Closely coordinate activities with ADB,/UNDP,/UNICEF and any other groups doing solid waste management work especially in focus areas where USAID/ESP is working such as Lhoknga.

6 Provide ongoing technical and capacity building assistance to PDAM, Dinas Kebersihan, communities and other groups (CARE, etc.) requesting assistance.

7 Present a three day workshop on integrated solid waste management program development. Target audience for the workshop should include Kabupaten/Kecamatan officials, development organizations such as CARE, NGOs, community leaders (particularly those from focus communities where USAID/ESP is working)). Consideration should be given to involving individuals from other USAID/ESP offices in Indonesia to share regional experiences (such as those described in Annex 6) and to provide an opportunity for internal capacity building for subsequent work in solid waste management in other regions of Indonesia. A recommended general agenda for this three-day workshop follows:
   a. Day 1 - Sustainable best practices in Integrated Solid Waste Management (ISWM)
      i Solid waste management planning
      ii Waste generation issues
      iii Primary collection
      iv Secondary collection and transfer
      v Disposal
      vi Recycle reuse and reduction processes
   b. Day 2 – Developing ISWM at the government (Kabupaten/Kecamatan) level
      i Technical considerations
         (1) Secondary collection program design and operation
         (2) Disposal area design and operation
         (3) Maintenance program development
      ii Financial/economic considerations
         (1) Full cost accounting and budgeting
         (2) Cost recovery
      iii Institutional considerations
         (1) Coordination with community level primary collection programs
      iv Legal/political considerations
         (1) Regulatory environmental impact assessment
      v Social/cultural considerations
         (1) Public information and participation programs
         (2) Informal sector issues
   c. Day 3 – Developing ISWM at the community level (using capacity building elements in the annex of this report as a foundation for the community section agenda) – aimed at community based organizations that USAID/ESP is working with and also NGOs and other groups such as CARE, Mercy Corp., etc. who are developing new communities in the region.

8 Select and develop pilot projects intended to demonstrate key elements of integrated solid waste management. The style projects could include some of the following:
   a. Market area or community level backyard compost projects
   b. Community level cart based collection program design and implementation
   c. Community level needs assessment and program design
   d. Government level full cost accounting and budgeting assessment
   e. Disposal area selection and consensus building
   f. Community level public information and public participation program

9 Present a pilot projects showcase workshop after sufficient time to get results from pilot projects. The second workshop should also emphasize the progress that has been made by any of the solid waste management participants in the region.

ANNEXES

ANNEX 1
INTEGRATED SOLID WASTE MANAGEMENT SOUND PRACTICE SUMMARY

ANNEX 2
WASTE GENERATION CAPACITY BUILDING

ANNEX 3
PRIMARY COLLECTION CAPACITY BUILDING ELEMENTS

ANNEX 4
SECONDARY COLLECTION AND TRANSFER CAPACITY BUILDING ELEMENTS

ANNEX 5
DISPOSAL CAPACITY BUILDING ELEMENTS

ANNEX 6
MEDAN USAID/ESP SOLID WASTE INITIATIVES INSPECTION REPORT

ANNEX 7
MENGEMBANGKAN LAYANAN PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

ANNEX 1 – INTEGRATED SOLID WASTE MANAGEMENT SOUND PRACTICE SUMMARY

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Successful solid waste management programs require good planning. This must include an accurate assessment of existing resources and deficiencies so as to define what is required to improve or expand existing solid waste management practices.

Good planning that accurately defines solid waste management needs is particularly important in regions where economic resources are limited. In those areas, solid waste management programs must compete with all of the other necessary public services that must be funded. This requires that public officials prioritize services that are most important to the community. Effective planning also aims at assuring that necessary services are accomplished with the minimum level of assets necessary to perform the service effectively.

To achieve this, there are a number of steps that public officials can take to accurately determine the solid waste management needs for improvement or expansion of their programs. These steps include the following:

1. **A complete inventory of all existing solid waste management assets (personnel, equipment and structures) is necessary. In many cities, a needs assessment must look at both primary and secondary collection activities.**
   At the primary neighborhood or kelurahan levels, the needs assessment must look at how individual residential generators get their solid waste to communal collection points where the waste enters the secondary municipal level program. For example, kelurahans or community groups that provide door-to-door residential solid waste collection may be responsible for the management of carts and personnel who provide door to door collection service. Similarly, municipalities responsible for secondary collection and transport should complete an inventory that includes the location and physical characteristics of communal collection points, as well as the vehicles and personnel involved in the secondary collection and transport process.
2. **Each jurisdiction undertaking a needs assessment should then define the deficiencies that prevent them from providing effective service.**
   Some of these deficiencies may be quite evident by simply identifying locations where solid waste inappropriately accumulates. In other cases, some analysis is required to define the deficiency as would be the case in measuring the manner in which existing resources are applied.
3. **Once program deficiencies have been identified, the means for correcting them must be clearly defined and planning should commence to implement improvements.**
   Improvements may be accomplished by the funding and allocation of additional assets (equipment and personnel or by modifying the manner in which existing resources are applied. At a minimum, planning should include an assessment of the existing capacity of existing vehicles and staff to optimize their collection activities.

Time and motion evaluations are often used for this purpose. In areas with limited financial resources, there may be a necessity to prioritize improvements so that they can be accomplished over a period of time that may be defined by available financial resources.

The following presents recommended activities and criteria that should be incorporated into a solid waste management needs assessment for local areas. Once this assessment has been completed, improvements can be planned and implemented. It is important that implemented improvements be based on sound practices that are practical and sustainable for the region in which they are to occur. An assessment of what defines a sound practice follows the needs assessment steps and criteria.

Needs Assessment Steps and Criteria

Step 1: Conduct Collection Situation Analysis		
1.	Gather background data	a. Applicable laws and regulation b. Demographic c. Physical characteristic d. Land use
2.	Conduct inventory and assess existing conditions	a. Waste composition b. Generator storage and handling practices c. Collection service d. Diversion methods and programs e. Disposal facilities
3.	Obtain input from residents and businesses	
4.	Waste characterization	a. Source b. Types c. Quantities d. Seasonal Variations e. Composition f. Density
5.	Generator storage and handling practices	a. Container types used b. Accumulated waste Assessment
6.	Environmental, health and safety impacts	
7.	Impediments to best practices	
8.	Collection Service	a. Management and administration b. Collection practices c. Operational performance d. Environmental performance e. Financing methods and costs
9.	Diversion Methods and Programs	a. Formal: i. Reuse ii. Recycling b. Informal c. Reuse d. Recycling
10.	Disposal Facilities	a. Expected life (years) b. Operational impacts on collection equipment c. Compliance with regulations d. Cost

11.	Obtain Input from Residents and Businesses	a. Expectations for the type of service and its frequency. b. Willingness to co-operate in planning and implementation of improved service. c. Ability and willingness to pay for improved service
Step 2: Establish Program and Service Goals		
1.	Collection system planning guidelines	a. Collection is complex and costly b. There is no one solution c. Must balance service with ability and willingness to pay
2.	Typical public goals	a. Convenient point of collection b. Service reliability c. Enforcement of applicable laws d. Improved public awareness and behavior e. Adequate and sustainable funding f. Monitoring of the service provider g. Equity of costs and benefits received
Step 3: Identify Options for Improving Collection Service		
1.	Point of collection	
2.	Materials to be collected	
3.	Handling of recyclable materials	
4.	Method of collection	
5.	Collection frequency	
6.	Service provider	
Step 4: Evaluate Potentially Viable Collection System Options		
1.	Formulate scenarios for viable systems	
2.	Develop preliminary cost estimates for each scenario	
3.	Evaluate applicability of strategic element options	a. Point of collection b. Materials to be collected c. Method of collection d. Storage container type e. Frequency of collection
4.	Evaluation criteria	a. Compliance with laws and ordinances b. Cost effectiveness c. Health/Safety d. Environmental compatibility e. Effectiveness f. Public acceptance g. Efficiency
5.	Point of collection options	a. At the door b. At the building c. Waste pooling sites
6.	Method of collection:	a. Manual collection b. Semi-automated collection c. Automated collection
7.	Materials to be collected	a. Bulky wastes b. Construction and demolition wastes(C&D) c. Yard wastes
8.	Storage container type	a. Plastic bags b. Metal or plastic rigid containers c. Rollout carts d. Large metal or plastic bins

9.	Collection frequency	a. Twice weekly b. Three times weekly c. Six times weekly d. Daily (seven times weekly)
10.	Formulate potentially viable system scenarios	
11.	Develop preliminary cost estimates for each scenario	
12.	Use data from operational experience and assessment of existing collection system	
Step 5: Select the Preferred Collection System		
1.	Solicit stakeholder input	
2.	Compare cost of each scenario with ability to pay	
3.	Make final decisions regarding strategic service elements & service provider	
4.	Make final strategic decisions	a. Point of collection b. Materials to be collected c. Storage container type d. Method of collection e. Frequency of collection f. Service provide
Step 6: Implement the Selected Program		
1.	Develop a public awareness and communication program	
2.	Establish the Program Funding Mechanism	a. Decide who will pay for waste collection service b. Decide how the money will be collected

In evaluating current and proposed solid waste management practices and technical options, planners must work to identify sound practices that are applicable to the specific conditions that exist in Indonesian rural and urban communities. There are a number of factors that must be considered in determining what defines sound practices.

In a general sense, a successful municipal solid waste management practice must be sustainable so that it can continue to exist beyond its initial implementation. There are many cases throughout the world where the availability of new equipment (such as waste collection vehicles) or the installation of new processing facilities (such as compost plants) did not fulfill expectations created at the time that these new systems were put into place.

In addition, insufficient institutional or financial capacity to operate and maintain a new system or equipment can lead to a situation where the new solid waste management asset cannot be operated, maintained, or managed successfully and the improvement fails. This is particularly the case in countries where donor-supplied equipment and facilities are put into place without the proper consideration or allocation of what it takes to keep the systems operable and efficient for their full technical life expectancy. System failures are common when a strong dependency is created on the donor process without establishing the ability to financially and technically support improvements or to implement equipment and facilities required to eventually replace donor systems.

Evaluating solid waste management conditions that define sound practices involves the investigation of a number of factors, including:

1. Availability of financial resources to implement new or enhanced processes
2. Level of economic development in the area of evaluation including relative cost of resources (capital, labor, etc.)
3. Level of technological development (availability of local equipment and services, etc.)
4. Level of human resource development in the municipal solid waste field (trained and competent technicians, managers, etc.) and in society in general (effective labor, etc.)
5. Physical conditions of collection areas including residences, container or TPS locations, access roads, etc.)
6. Physical conditions of disposal areas such as topography, soil characteristics, hydrogeology and the type/proximity of water bodies
7. General climate conditions that may influence system design features (temperature, rainfall, prevailing winds, etc.)
8. Specific environmental sensitivities of the region such as the extent of air pollution or the condition of water bodies near disposal areas, etc.
9. Solid waste characteristics including composition, density, moisture content, combustibility, recyclable content, and the inclusion of hazardous or biomedical waste in the municipal solid waste stream
10. Demographic and geographic characteristics such as size, population density, and infrastructure development, political jurisdictions, waste shed definitions
11. Degree to which solid waste management decisions are constrained by political considerations and the nature of those constraints
12. Existence or effectiveness of regulatory laws and enforcement
13. Policy initiatives that may exist or are under development that will influence the development of an effective solid waste management system
14. Social and cultural practices
15. Extent of informal practices such as solid waste scavenging in collection systems and disposal areas

All of the above influence the definition of sound practices for any region and they also account for the reasons why sound practices in the United States or the European Union may be different that those applicable to developing or transitional countries such as Indonesia.

1. SOUND PRACTICE – COLLECTION AND TRANSFER

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

When people think about solid waste management they usually visualize its collection. Collection and transfer is that part of a solid waste management system that is most visible to the public in any urban area. It also accounts for a significant portion of the cost for municipal solid waste management. In industrialized countries, collection costs range from 60 to 70% of the total cost; while developing or transitional countries spend from 70 to 90% of the total cost of solid waste management on collection and transfer.

While the percentage of total cost allocation to collection is higher in transitional countries, this does not mean that a collection system is more efficient. Typically, the service is

inefficient since workers are often unmotivated, untrained and insufficiently compensated. In addition, collection is often carried out using obsolete equipment that is not well maintained. Typically, the level of service is determined by the stature of the collection area where poor areas receive a lower level of service. The high percentage of cost allocation for collection is also affected by the frequency of collection. In developing and transitional countries, collection of solid waste can occur frequently, in some cases daily.

Sound practices in many industrialized countries include the use of compactor trucks and other such vehicles specifically designed for the collection of solid waste. Non-compactor trucks are also used to collect solid waste. Some communities provide collection through a container-based system where solid waste receptacles are placed at strategic locations for receipt of waste from generators and eventual pick up by the community or a private contractor.

The type of equipment used for collection is a function of a number of factors including:

1. The cost of labor and services
2. The nature of collection routes (street widths, etc.)
3. Historical practices
4. Recycling practices

Generally, solid waste collection in many Indonesian cities is divided into two phases including:

1. Primary collection which gets generated residential waste from the residences or commercials establishments to collection points and
2. Secondary collection where solid waste placed at communal collection points is picked up by municipal staff or private contractors and transported to processing or disposal locations.

Primary Solid Waste Collection at the Neighborhood Level

Primary collection is the means by which solid waste is collected from individual residential generators and transported to consolidation points where it enters the secondary collection system. Consolidation points may consist of fixed communal collection structures such as TPS or containers that are strategically placed to receive waste. There are three general approaches by which primary solid waste collection can be achieved:

1. Residential generators may be required to carry their solid waste to a communal collection location which may be a fixed TPS or container. If this approach is taken, sufficient collection points have to be provided to make it convenient for residential generators to dispose of their waste materials without going long distances.
2. Residential generators may be served by door-to-door collection provided by either neighborhood groups or smaller units of government such as kelurahans or provided by small micro enterprise contractors who collect solid waste from individual residences for a fee. Once collected at each residence, the waste is then transported to the communal collection points that serve their neighborhoods.
3. Block collection which utilizes mobile collection points where residents carry their waste at prescribed days, times and places to a passing collection vehicle which stops at a designated location to receive the waste.

Primary Collection Equipment Resources - The use of collection vehicles (manual or mechanized) is an important element that influences the design and efficiency of both the primary and secondary collection processes. Vehicles have to be selected on the basis of a number of factors including: 1) loading capacity, 2) the number of crew required to operate the vehicle, 3) costs of owning and operating the vehicle, 4) operational and maintenance requirements and 5) on the accessibility of the service area to a particular vehicle design.

Handcarts and pushcarts are often used as a low-cost means of collecting solid waste door-to-door in primary collection. Under normal service, manually operated handcarts and pushcarts are limited to about 1 kilometer with an effective speed of about 3 kilometers per hour. They are generally well-suited for the conditions normally found in low income or other areas where narrow streets, low waste generation rates, high waste density, and population density prevail. Use of handcarts and pushcarts may be warranted for primary collection in many Indonesian communities since they are typically non-polluting, inexpensive to manufacture and operate, simple in design and can usually be manufactured locally. This makes them a very important element of the sustainable low-cost technology collection approach particularly suited for primary collection.

Primary and Secondary Collection Interface - One of the most important aspects of successful waste collection is the physical interface between the primary and secondary collection processes. In Indonesia, the existing interface configuration is one of the main problems with the current collection program. Insufficient and improperly designed or located TPS collection points make it difficult to collect solid waste in a controlled and thorough manner. The nature of the interface is determined by the way that primary collection is accomplished.

There are a variety of different cart designs that have been used throughout the world and examples are shown in the figure on the following page. In selecting a cart design, attention should be paid to designs that allow easy handling since the carts have to be moved by manpower. This limits their loading capacity. An appropriate cart volume should range between 0.5 to 1.5 cubic meters with an upper weight limit of about 500 kg. The ultimate size of handcarts and pushcarts will also be dependent on the specific configuration and characteristics of the areas to be collected. Areas with steeply sloping roadways and difficult travel surfaces will affect cart design and capacity.

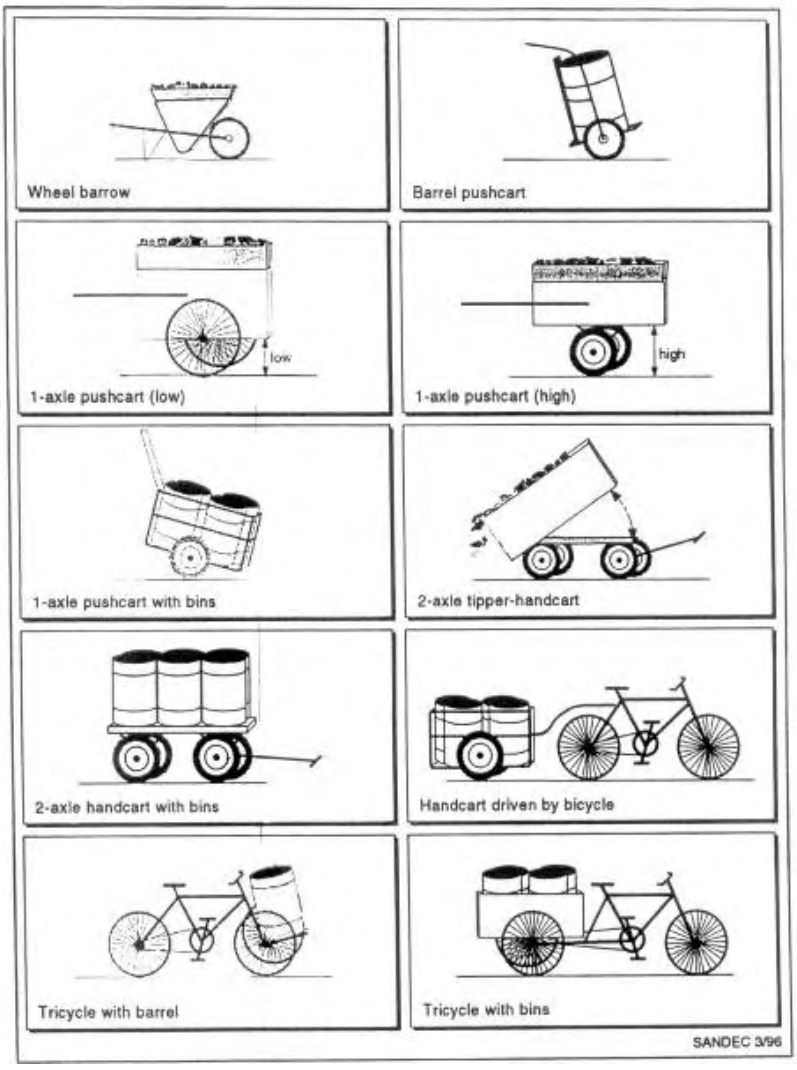
One important aspect of the proper design of a collection cart is the manner in which they are loaded and unloaded. To the degree possible, the need to dump the waste on the ground for transfer to a larger transport vehicle should be avoided. This practice is messy and significantly contributes to litter. It is also tiring work and exposes collection personnel unnecessarily to health risks in handling solid waste materials. (In areas where households use plastic bags for waste storage, this problem is less significant.) One way to overcome the need for dumping the waste on the ground is to use bins, large bags or barrels within the carts that can be lifted out for transferring material to larger vehicles.

Communal storage where household generators bring their waste to communal storage facilities such as roll-off container or concrete enclosures is the cheapest alternative in terms of direct cash requirements. In this case, households contribute in-kind services for primary collection by either providing the effort to carry their solid waste to the collection points or paying somebody else to do it. However, for this approach to be practical, communal storage points have to be sited within a reasonable distance from generators to be acceptable to them. Generally, residential generators will willingly carry

their waste between 50 and 100 meters to communal storage points. However, greater distances often leads to their seeking "more convenient" alternatives that may include illegal dumping.

In using mobile collection interfaces or block collection, residential generators will still choose to only carry their waste about 50 to 100 meters to a mobile collection point. Such locations may consist of a handcart or motorized vehicle. If the mobile collection point were a handcart, the primary collection process would still include the transportation of the collected waste in the cart to another collection point for transfer to the secondary collection system vehicle.

The most costly, but most reliable, primary collection approach is house to house collection in that it serves every household and does not rely on the willingness of generators to provide the transportation of their waste to the collection point. In many developing countries, door-to-door curbside collection with manually operated vehicles is the most widespread collection method. Household contribution in this approach is minimal in that they are only responsible to bring their solid waste to curbside or to make it available to the collector at the agreed to collection frequency.



Examples of Handcarts and Tricycles

In some cases where accessible roads are adequate, house to house collection with motorized vehicles may be more efficient than manually operated carts. However, the roadways on which the truck travels have to be able to support the traffic disruption that could occur as a result of the truck stopping frequently to collect waste. In many Indonesian communities, this would not be practical since other vehicles would not be able to move past a truck that had stopped to collect solid waste from its generators.

The main advantage of door-to-door collection with mechanized equipment is that the collected waste can be transported directly to the disposal area without any transfer to another conveyance vehicle. This effectively eliminates the interface between primary and secondary collection systems. One of the limitations of this approach is that if certain households are in inaccessible areas along the collection routes, collection personnel will have to travel considerable distances by foot to retrieve solid waste to bring it back to their vehicles if complete collection coverage is to be maintained.

In planning, recognition must be given to the fact that the primary and secondary collection processes are interdependent and, for planning purposes, do not necessarily operate as a single function. Developing an effective level of service must recognize this fact since the responsibility for each collection function may be under the jurisdiction of a different level of government.

The interface between the primary and secondary collection process is extremely important in determining the overall effectiveness of the collection program. If the primary collected waste is not picked up regularly at the collection or transfer sites by the secondary collection system, solid waste will accumulate to a point where containers or TPS locations may become full. Waste accumulations can lead to significant litter or odor that discourages residents and collectors from using the collection system. This is also a critical issue if mobile collection points are used since waste collectors will have to lose considerable time waiting for trucks to receive their collected waste or they may opt to dump the collected refuse elsewhere or at the site where the truck will eventually be. ***As a result, close cooperation between those providing the primary collection service and those that provide secondary collection is critical if the overall collection program is to be successful.***

Secondary Solid Waste Collection and Transport at the Municipal Level

Secondary collection and transfer occurs when the municipality picks up solid waste from communal collection points or containers and transports it to processing facilities or a disposal site. Secondary collection must be accomplished in an effective manner so as to keep communal collection points clean and available for service.

Communal collection points may not be serviced properly or at a sufficient frequency to keep solid waste of accumulating and spilling over. Since these are generally located in the individual neighborhoods where waste is generated, ineffectively managed collection points will add to the perception of "garbage in the streets". If there are insufficient communal collection points, residential generators will often simply place their solid waste in "more convenient" informal locations. These uncontrolled locations are often not serviced until they become a major problem because of odor, fires, and vectors (flies, rodents, etc.)

Secondary Collection Equipment Resources - Motorized vehicles are normally required for secondary collection where greater volumes of solid waste must be managed. This is especially the case when solid waste must be transported long distances to remote disposal areas. However, in many cities throughout Indonesia, mechanized vehicles are limited to larger roadways where they are able to traverse easily. They cannot be effectively

used in some narrow neighborhood roadways. While many sophisticated vehicles have been developed in industrialized countries for solid waste collection, these may not be appropriate for the collection schemes that may be required in the region because of their cost, complexity and the characteristics of Aceh roadways. Examples of typical mechanized equipment used in solid waste management are shown on the following page.

Additionally, there is considerable advantage in selecting a vehicle type that is manufactured locally or already in use for other general purposes within the city. Attempting to standardize the type of secondary collection mechanized vehicle helps to reduce vehicle downtime by making maintenance easier to perform since mechanics are more familiar with the equipment and spare parts may be more readily available. In some cases, agricultural tractors and trailers have proved to be a suitable choice for mechanized vehicle transfer of solid waste. This is especially the case in areas close to the disposal locations.

Personnel Resources - The number of personnel required to perform collection services is dependent on the type of vehicle used, the form of interim storage between primary and secondary collection and the operational pattern adopted in either the primary and secondary collection process. Labor-intensive systems are more likely to be used in areas where sophisticated motorized equipment cannot be considered due to high-cost or difficult operational conditions.

One of the key considerations that need to be given in developing a sustainable collection system (especially one that is labor-intensive) is the need to make sure that collectors are properly compensated. In many regions of the world, solid waste collectors have a low social status and are often paid insufficiently to even earn a living for their families. This leads to low morale and significant job turnover where any training provided to collectors is lost as a result of collection personnel leaving for better jobs. Additionally, solid waste collectors will often retrieve recyclable materials as they collect solid waste so as to supplement their earnings. This practice can influence the efficiency of collection by reducing the time that a collection crew actually spends collecting solid waste.

Collection Frequency - ***One of the key decisions that must be made in defining solid waste collection services is the frequency at which the solid waste is collected at both the primary and secondary level.*** In some instances, decreasing the frequency of collection can provide sufficient savings to allow enhancement or expansion of the collection services. However, this is only practical in areas where solid waste storage does not create aesthetic problems such as odors. ***In Indonesia, prevailing temperatures will, more than likely, require frequent collection.*** As a result, the collection system has to provide the means by which residential solid waste is removed from residences daily. Organic solid waste will start to decompose within one or two days. Beyond that time offensive odors may result. The primary collection system has to provide the means by which solid waste is removed from the residences daily while the secondary system must manage the material at the TPS or containers frequently enough so that odor and vector (flies, etc.) problems do not develop at the collection points. When this latter situation occurs, nearby residents sometime start fires to eliminate resulting odor and vectors. However, this often results in the replacement of an aesthetic problem with a potentially greater health impact due to the migration of smoke from the burning solid waste to nearby residences and businesses.

In some circumstances, consideration should be given to the construction of transfer depots that would allow for greater consolidation of solid waste material prior to transport to disposal locations. Since transfer depots may serve more than one residential area or jurisdiction depending on its location, they should best be developed by the municipality as

an enhancement of its container-based collection services. In the coordination of a thorough needs assessment, potential locations for transfer depots may become evident.

Additional detail concerning the SWM collection process is presented in the solid waste collection primer in Annex 7 (under separate cover).

2. SOUND PRACTICE – REDUCTION AND RECYCLING

What is a sound practice?
A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Solid waste source reduction and recycling are a means of diverting a portion of the solid waste stream from disposal facilities to recovery and reuse. Some solid waste components have value if they can be effectively separated from the overall solid waste stream without too much contamination. Common recyclables include ferrous and nonferrous metals, construction debris, scrap tires, paper/cardboard, plastics, textiles, glass, wood/timber, animal bones and feathers, waste oil and grease, and cinders.

In some urban centers such as those in Australia, Japan and Korea where economic resources exist to support formal recycling programs, a high degree of waste reduction, source separation, and recycling occurs. These programs have evolved through extensive public education and practices such as curbside collection. In Singapore, for example, about 38% of the total generated municipal solid waste is recycled by commercial companies. The recycled materials come from industry and commercial establishments as well as the extraction of commercially viable waste components such as papers, cardboard, textiles, plastics, and glass collected from households. The level of economic resources available in these locations defines the above as sound practice for those areas. However, for areas with more limited resources these targets may not be realistic.

There are many examples throughout the region of government support for waste reduction and recycling programs. For example, in China and Vietnam waste recovery and recycling has been organized at the city level and programs have been supported by national ministries. Major cities have public and private companies that collect recyclables from offices, institutions, and factories. They also have neighborhood redemption centers where people can sell materials such as bottles, paper, and clothes. In many developing countries, informal source separation and recycling have always been practiced by an informal sector (comprised of waste pickers, buyers, traders, and recyclers). This practice has been based on inherent frugal habits, resource scarcity, and high levels of poverty. These traits have also fostered a strong reliance on repair industries that reduce the amount of waste generated.

Materials that have historically been separated or picked out from mixed wastes include ferrous and nonferrous metals, papers/cardboard, glass, plastics, clothing, leathers, animal bones/feathers, books and household goods which are repaired and sold in second-hand markets. Some typical examples

Informal recycling occurs at three points in a typical solid waste management system:
1) Initial recycling begins with scavengers removing materials from containers or waste accumulations before collection.
2) The second level occurs within the collection process itself when collection personnel remove materials as they are collecting the waste.
3) The third level of recycling occurs at disposal areas where materials are removed by scavengers from waste that is dumped.

of the informal recycling industries are those which recycle broken glass into bottles, waste plastics to toys and shoes, and waste paper to paper board. The activities are mainly driven by the scarcity and expense of raw materials. Scavengers will recover any materials that may then be sold to small and large dealers and wholesalers who may in turn sell the material to manufacturing facilities or larger consolidators. Many large industries deal entirely with recyclables such as papers, ferrous metals, plastics, and glass.

The economic stimulus for this activity is the fact that scavengers will often earn their livelihood by recovering and selling these materials. (***Effective planning of solid waste management improvements in any jurisdiction need to consider the effect of scavengers within their programs.*** Occasionally, cities in developing countries have attempted to ban scavengers from dump sites to discourage dependence on this activity as a livelihood. However, such regulations have proved near impossible to enforce. Since many of the people involved in scavenging rely on the process for their livelihood, the social implications of eliminating practice must also be considered in solid waste management planning.)

Based on observations in many developing countries, informal recycling occurs at three points in a typical solid waste management system. Initial recycling begins with scavengers removing materials from containers or waste accumulations before collection. The second level occurs within the collection process itself when collection personnel remove materials as they are collecting the waste. Recovered materials are normally placed in sacks, boxes or whatever may be convenient on a collection truck. Unfortunately, this form of recycling can significantly impact collection efficiency by slowing down the collection process. The third level of recycling occurs at disposal areas where materials are removed by scavengers from waste that is dumped. People who scavenge at disposal areas generally work in very poor conditions at considerable health and safety risk. Many of the people who do this live at or near the disposal site. NGOs in some countries have assisted waste scavengers in forming cooperatives to collectively obtain source-separated wastes. Some of the ways scavengers can be brought into a formal recycling program include the following:

1. Subsidize personal protective equipment and clothing to reduce the health risks of scavenging
2. Provide access to basic health care in inoculations against illnesses such as tetanus
3. Regulate scavenging and waste picking by providing designated areas at which the activities allowed
4. Assist scavengers and waste pickers to organize cooperatives so as to increase their earnings and working conditions
5. Help to control harassment and image issues associated with street pickers in scavengers

In larger landfills, scavengers are a major problem and often impede proper operation of the disposal site. The materials recovered from disposal areas are usually of a lower quality than those removed earlier in the solid waste management system since they are usually dirtier and more contaminated because of their contact with other materials placed into the disposal area. ***As a result it is generally desirable to shift recycling toward the generation and collection end of the system and away from the disposal end. This forms the basis for many of the successful recycling programs that have been developed throughout the world.***

Any recycling activity, formal or informal, is driven by the availability of markets for the recover materials. Generally, industries are interested in using recycled materials only when the cost of doing so is less than the cost of using virgin materials in their manufacturing

processes. In other words, available markets provide the economic incentive for the activities undertaken by formal and informal recyclers. However, successful recycling is not guaranteed simply by available markets. Solid waste program managers must also give attention to making recycling programs economically efficient and maximizing public participation.

The following is a general sequence of activities that should be followed in the implementation of a successful recycling program.

1. Identify the goals for the recycling program
2. Characterize recyclable material volume and accessibility within the waste stream
3. Assess and generate political and public support
4. Assess markets and market development strategies for recyclables
5. Assess and choose technologies and practices for collection and processing
6. Consider the effect of the proposed program on informal recyclers (also consider the effect of the informal recyclers on the proposed program)
7. Develop a budget and an organizational plan
8. Implement education and publicity program
9. Commence program operation
10. Supervise the ongoing program and continue publicity/education
11. Review and adjust program as necessary based on the experienced gained during its implementation.

The long-term success of any formal recycling program depends strongly on public participation. Citizens and local officials must be constantly reminded of the environmental, economic, and social reasons for reducing landfill waste. Program publicity, promotion, and education must be ongoing to accomplish this.

3. SOUND PRACTICE – COMPOSTING

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Composting involves the aerobic biological decomposition of organic materials to produce a stable humus-like product. Backyard composting is considered to be a form of source reduction or waste prevention because the materials placed into a backyard compost system are completely diverted from the municipal solid waste management system. Community level composting programs that process source-separated organics or mixed MSW are considered forms of recycling since the material has usually entered the formal solid waste management program before diversion to the composting process.
In this discussion two approaches to composting are highlighted: those at the household level and larger facilities that are managed by municipalities. The latter is often run by machine and considerable more complex than one managed at the household level. As has been demonstrated in this Project's pilot studies, household composting is a practical, affordable and low maintenance way for a community's citizens to reduce solid waste.

While a significant percentage of the residential waste stream is organic material, the other components can significantly affect the viability of producing compost from a mixed waste stream. Composting organic materials, especially organic waste diverted from markets, can significantly reduce waste stream volume from these facilities.

The quality of produced compost depends on a number of factors including:

1. Particle size,
2. pH,
3. The presence of soluble salts,
4. Stability, and
5. The presence of undesirable components such as weed seeds, heavy metals and undesirable materials such as plastic and glass.

In many industrialized countries where solid waste management costs are high, composting offers significant economic advantages. However, this economic driver is often not a major factor in many developing countries where disposal costs are low because of substandard disposal practices. The challenges to developing effective compost programs include the following:

1. Developing markets and stable end uses of the produced compost
2. A lack of standards for finished compost
3. Lack of experienced designers, vendors, and technical staff available to many municipalities
4. Potential problems with odors in poorly managed processes
5. Potential problems controlling contaminants that affect the agricultural value of the compost
6. Inadequate understanding of the biology and economics of composting

As long as the informal and formal processes for eliminating non-organic fractions from the waste stream can be brought into control, a sound practice for local governments in developing countries is to emphasize the diversion of organic material from the waste stream to small to moderate scale composting systems. The high percentage of the organic fraction provides the greatest opportunity for diversion from disposal facilities.

Several factors determine the chemical environment for composting including:

1. The presence of an adequate carbon (food)/energy source,
2. A balanced amount of sufficient nutrients,
3. The correct amount of water,
4. Adequate oxygen,
5. Appropriate ph, and
6. The absence of toxic constituents that could inhibit microbial activity.

The ratio must be established on the basis of available carbon rather than total carbon. An initial ratio of 30:1 carbon/nitrogen is considered ideal. To lower the carbon/nitrogen ratios, nitrogen-rich materials (yard trimmings, animal manures, biosolids, etc.) are added.

Because the water content of most solid waste materials introduced to the compost process is not adequate, water is usually added to achieve the desired rate of composting. A moisture content of 50 to 60 percent of total weight is ideal. Excessive moisture can create anaerobic conditions, which may lead to obnoxious odors. Adding moisture may be necessary to keep the composting process performing at its peak. Evaporation from compost piles can also be minimized by controlling the size of piles. pH affects the amount of nutrients available to the microorganisms, the solubility of heavy metals, and the overall metabolic activity of the microorganisms. A pH between 6 and 8 is normal.

The four composting technologies are windrow, aerated static pile, in-vessel, and anaerobic composting. Supporting technologies include sorting, screening, and curing. The technologies vary in the method of air supply, temperature control, mixing/ turning of the material, and the time required for composting. Their capital and operating costs also vary considerably. One or two screening steps and possibly additional grinding are used to prepare the compost for markets. For screening to successfully remove foreign matter and recover as much of the compost as possible, the compost's moisture content should be below 50 percent.

Effective composting requires control of the process. Some of the technical aspects that must be considered in composting include the following:

1. **Backyard composting -** Backyard composting is a good way to manage household kitchen garden waste. While this is the smallest scale of composting and the material be composted comes only from one source it is a sound approach when:
   a. A significant number of households have sufficient room for compost pile—it is also practical for an individual household to have its own compost
   b. There is a need for compost at the individual residences
   c. The compost activity is culturally familiar to the population in general
   d. The waste stream to be composted contains primarily vegetable matter which can help to control rodents and insects.
2. **Coordinated backyard compost systems -** Backyard composting generally consists of household-level aerobic decomposition of household organic garden and kitchen wastes. The resulting compost is usually used at the residence itself for organic fertilizer. Sound practice in organized backyard composting systems includes the following:
   a. Government purchase or subsidy of backyard composters
   b. An intensive program of public education
   c. The implementation of small scale backyard composters as pilot project to demonstrate the technology and its application.
3. **Volume reduction -** All composting processes result in volume reduction because of the action of bacteria that transforms waste material components into humus, steam and gases. In addition, insects and microorganisms feed on organic material. Additional volume reduction occurs through removal of non-compostable materials during pre-processing or final screening. Because of the above actions, 100 tons of compostable waste material can produce about 30 to 50 tons of compost depending on the physical characteristics of the feed material.
4. **Duration of the composting process -** Composting is completed when the compostable materials have been completely converted to humus. Final compost can be tested by re-wetting the material and observing if it heats up again. If it does heat up, this indicates that there are still uncomposted materials in the pile that begins to stimulate biological action. Most aerobic composting processes require a period of active composting (generally from 21 to 60 days) and a period of curing (generally from 6 to 24 months). The composting process can be accelerated by intensive aeration through forced air systems and through inoculation of the piles with suitable bacteria to stimulate biological action.
5. **Marketing of compost -** Effective marketing of compost is important to sound practice. In industrialized countries, compost is ordinarily considered to be a soil amendment, rather than a fertilizer because of its relatively low nutrient value. It is considered to have value as a soil conditioner for dense or sandy soils, assisting all soils to retain moisture, synthetic fertilizers, and natural nutrients. It is useful in regulating soil temperature and in preventing erosion. Compost has also been known to inhibit destructive agricultural diseases and pests.

6. **Small-scale composting of animal wastes -** Composting and digestion of bones is often implemented as a small industry in some developing countries. This process can produce ingredients for the manufacture of fertilizer, animal feed, and glues. Small-scale aerobic composting of animal wastes such as manures, hide scrapings, and tannery and slaughterhouse wastes can also produce fertilizers but care is required because of potential pathogens.
7. **Pre-processing -** Pre-processing is a technical component of almost all composting systems above the level of backyard composting. Pre-processing is usually necessary to create the conditions for bacterial action and usually consists of three separate types of operations:
    a. Separation or removal of oversize, non-compostable, or dangerous materials;
    b. Size reduction to create many small particles suitable to sustaining bacterial action by increasing the surface area available for biological action; and
    c. Blending of materials to adjust the carbon-nitrogen ratio, moisture content, or structure of the materials to be composted so as to optimize the composting process.

Mechanical pre-processing is usually the most costly part of a community level composting system. It is also the most likely to breakdown. Because of this, sound practice in composting involves minimizing pre-processing to the extent possible by pre-selecting the waste streams to be composted through source separation and separate collection.

1. **Windrow and active pile systems -** A sound and simple form of composting involves the construction and maintenance of piles of compostable material. The piles, called windrows, form the basic environment for compost bacteria and other organisms to accomplish decomposition and biological conversion. Important considerations in using windrows for composting include:
    a. The size of the windrows, which must be of sufficient mass to allow for heat build-up. The composition of the wastes and the climate in the area where composting occurs are the two primary factors in determining windrow size.
    b. The shape of the windrows, which is related to the type of aeration that is used and the type of equipment used to aerate;
    c. Whether the windrows are open or covered (This usually depends on the climate and the moisture content of the waste); and
    d. The spacing of the windrows, which is dependent on the size of the site and type of equipment used to turn and process the material.

    Active pile systems require manual or mechanical turning of the windrows, with crews using shovels or rakes, or with equipment such as a bulldozer, tractor, or windrow turning machine. Turning aerates the piles, blends the materials, brings about additional size reduction, and prevents excessive buildup of temperature to the point of spontaneous combustion. An active pile system:
    a. Has relatively high land use requirements;
    b. Uses a varied amount of labor, depending on whether compost turning is manual or mechanical;
    c. Has low capital cost and low-to-moderate operating cost;
    d. Can be developed without purchase of specialized equipment. Mechanical turning can be done with loaders or bulldozers, which are common equipment in solid waste management functions.
    e. May use a variety of compostable materials; and
    f. May release odors during turning early in the composting cycle. A large buffer zone between the composting site and neighboring residences may be needed, especially if the windrows are infrequently turned.

2. **Windrow turning machines.** Specially designed windrow turning machines have been developed in the US, Asia, and Europe. These vary in size from a tractor attachment to the large specially designed turner, which straddles the windrows. Windrow turning machines allow for production of a more uniform compost. They decrease labor costs but increase the capital costs of active pile systems. Compared to bulldozers, however, specialized windrow turning machines are more effective in aerating windrows and may therefore be a cost-effective alternative.
3. **Static pile systems -** In static pile composting systems, the windrows are not turned but are aerated continuously or periodically using forced air systems. Static piles typically require a site with aeration channels built into the pad on which the piles sit. Piles are built over this channel, and a network of perforated piping is introduced during placement into piles of the materials to be composted. During composting, air is blown or drawn by pipe systems driven by electric or gas motors through the static piles to provide aeration.
4. **In-vessel systems -** In an in-vessel system, much of the composting process is carried out indoors or inside a vessel with a large, enclosed chamber in which mechanical mixing and/or forced aeration are performed where moisture, air, and temperature can be controlled to create the optimal conditions for composting. In-vessel systems offer protection from weather conditions, better odor control, and shorter periods of active processing, but they are expensive to build and operate. Their status as a sound practice for developing countries is open to question, especially since equipment and parts typically have to be imported and paid for with foreign exchange.

There are many successful small and medium-sized composting installations that are functioning successfully in countries such as China and India using the above technical configuration and processes. Unfortunately, there are also examples of many attempts at establishing community level composting in developing or transitional countries that have failed. This is particularly the case where large mixed waste compost plants have been constructed. Common reasons for such failures have included:

1. **Economic Failure** - In some cases, there has been an inability to secure sufficient waste to process as a result of the competing costs of disposal alternatives. Compost plants have also failed as a result of an inability to market end-product compost. This is often a function of agricultural practices in the region where the compost is produced. These practices will determine the external demand to use the material as a soil conditioner. Experience across the world has shown that compost marketing works best when:
    a. Available markets are near the source of production
    b. Compost producers are willing to transport it to the consumers
    c. Compost is priced below other commercially available soil conditioners or given away to the consumers.
2. **Technical Failure** – Composting failures around the world have been due to technical issues such as:
    a. Failure of mechanical pre-processing systems used to condition the solid waste for composing,
    b. Failure of the biological process as a result of not controlling the technical parameters (moisture content, carbon/nitrogen ratio, etc.) required for effective compost production
    c. Insufficient organic content in the mixed waste stream to support the process.

The compost systems that have generally been effective across the world are those that focus on the use of source-separated materials high in organic content. Examples of such materials include animal and vegetable waste such as that derived from market applications. The marketability of compost can be controlled by selectively accepting feedstock materials. Feedstock material should be carefully controlled to ensure consistent compost quality. The definition of source-separated organics can include specific waste from markets, food scraps, yard trimmings, and sometimes paper. The advantage of source-separated organics composting is the ability to produce relatively contaminant-free compost. A contaminant-free feedstock is important for producing high-quality compost.

The steps that may be taken in developing an effective compost program include the following:

1. Identify goals of the composting project
2. Identify the scope of the project—backyard, yard trimmings, source-separated, mixed MSW, or a combination
3. Get political support for changing the community's waste management approach
4. Identify potential sites and environmental factors
5. Identify potential compost uses and markets
6. Initiate public information programs
7. Inventory materials available for composting
8. Visit successful compost programs
9. Evaluate alternative composting and associated collection techniques
10. Finalize arrangements for compost use
11. Obtain necessary governmental approvals
12. Prepare final budget and arrange financing
13. Construct composting facilities and purchase collection equipment, if needed
14. Initiate composting operation and monitor results

4. SOUND PRACTICE – DISPOSAL

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Disposal areas are an indispensable part of any effective solid waste management program. This is the case no matter how effective solid waste recovery or processing is. The most efficient waste reduction, compost or waste-to-energy will leave some residuals that must be disposed of in landfills. Current practices in developing and transitional countries have ranged from uncontrolled open dumps to secure landfills depending of the particular circumstances in each locale.

There is a broad range between the technical and design standards that exist for industrialized country landfills such as those in the U.S. and the E.U. and the current disposal sites in many Ivorian communities. Sound disposal practice in Indonesia will not necessarily replicate U.S./E.U. standards. However, it should include the development and operation of controlled landfills that take into consideration site features aimed at mitigating environmental effects. To accomplish this, operational procedures must be used that are aimed at the safe disposal of solid waste in a **controlled** manner.

Disposal landfills throughout the world can be grouped into three general categories:

1. Open dumps
2. Controlled dumps
3. Secure landfills

Disposal facilities in developing countries most often fall somewhere between open dumps and controlled dumps. Uncontrolled, open dumps are not a sound practice, but controlled dumps and secure landfills can provide effective disposal of solid waste within reasonable standards of performance and environmental protection. In addition, countries with well-developed landfill standards have gone through a gradual technology evolution to reaching their current regulatory requirements. While countries with emerging standards can learn from the process of landfill standard evolution in other countries, a gradual pace of improvement may be warranted because of the extent of change required and the limited resources available to accomplish that change.

Open dumps have the lowest initial capital investment and operating cost of the three basic types of landfills. Many open dumps start as controlled dumps and degrade due to lack of management and other resources. Due to the low initial costs of open dumps, and lack of expertise and equipment, these degraded sites are common in developing countries. They pose significant risks to human health and the environment, especially as municipal solid waste becomes more dangerous through the introduction of industrial-based materials as industry is developed in a community. (Fundamental to landfill considerations is the relative mobility of pollutants as they flow through the soil to pollute groundwater and, ultimately, groundwater use points such as wells. Organic chemicals often associated with industrial waste have been found to be the most mobile of pollutants escaping from unlined landfills.)

While open dumping is not generally considered to be sound practice, it may be acceptable for very poor countries where cities are near deserts such as some areas of North Africa and the Middle East. Managers are often compelled to close open dumps and construct controlled landfills. However, the impact and reality of inadequate financial, technical and managerial resources means that an attempt to change open dumping practices and gradually upgrade existing sites is often warranted. Section 8 of the manual presents the criteria for establishing a landfill operations plan. While a good operations plan is necessary for any new landfill facility, the criteria can also apply to the upgrade of existing sites to controlled operations.

Effective landfills require **active** management where all functions are controlled by dedicated staff and managers responsible for all activities at the landfills. Observations at a number of the prototype community landfills indicate that many of the sites are not actively managed through full-time dedicated staffs who work at the facility during all hours of operations.

Based on worldwide experience, there are a number of sound practices that have been defined for controlled and secure landfills, including:

1. Leachate management and environmental impact minimization
2. Gas management and risk reduction
3. Access security
4. Record keeping to document operations
5. Waste compaction and daily cover
6. Documented and effective operating procedures, and worker training and safety programs
7. Establishment and maintenance of good community relations
8. Closure and post-closure planning

The following information defines what generally accepted sound practice in some of the above criteria.

Leachate Management - Leachate management is a key element in landfill design and operation. The natural decomposition of municipal solid waste, in combination with rain infiltration into the landfill site, causes contaminants to leach and flow toward the bottom of the landfill where it can enter the soil beneath the waste accumulation. The wetter the climate, the greater the potential risks of groundwater and surface water contamination from the landfill since the contact between water and solid waste is increased.

Since leachate can be expected to be generated in any landfill setting, the characteristics of the soils directly beneath the landfill are extremely important Low impermeable soils such as clay or silt can be moderately effective in treating leachate through a process called "natural attenuation". As leachate flows through soil, physical and chemical processes help to treat the leachate. Natural attenuation processes are minimally effective in permeable soils such as sand.

A secure landfill contains engineering features such as impermeable liners to allow the collection of all leachate and prevent the release of pollutants to the environment. Natural materials such as clay or synthetic materials such as high-density polyethylene sheets are often used to line the bottom and sides of landfills. The design standards in industrialized countries such as the U.S. and the countries of the E.U. have adopted a composite liner standard where both recompacted clay and a synthetic liner are used together.

To minimize the production of leachate, cover material should be applied at the end of each day that the landfill is operated. When a landfill is closed, a final cover is applied to isolate the solid waste from further contact with precipitation and to minimize the production of leachate after closure.

In lined landfills, leachate is retained by the liner and removed by a leachate collection system which is installed above the liner. This system is important in not allowing the leachate to build-up over the liner to increase the potential of leakage through the liner. The system usually consists of a perforated piping system which collects the leachate and allows it to be transported to a storage tank or a treatment facility tank. Periodically, leachate must be removed from the storage tank and treated or disposed of. The most common leachate management methods are: discharge to a wastewater treatment plant, on-site treatment followed by discharge to sewerage or surface water (depending on the quality of the treated leachate), and recirculation back into the landfill. All of these options generally require a pumping system.

The state-of-the-art liners and leachate collection systems described above are often too expensive for many developing countries. There are a few leachate management practices that are much cheaper and may be practical in some situations.

1. Municipal solid waste in an area with low rainfall can be partially dried at transfer stations (if they exist as part of the solid waste collection/transfer system prior to landfilling). This will reduce the leachate produced at the landfill.
2. For areas where pre-drying is impractical or where the soils are permeable (and where leachate runoff would therefore be a major problem), it may be necessary to site a landfill in an area with a steeper grade than would otherwise be chosen. In conjunction with a well-distributed leachate collection system, this can reduce the dangers of groundwater contamination. The actual grade required would depend on

the hydraulic conductivity of the soil, the stability of the graded surface, and other site-specific engineering considerations. The use of steeper grades, along with the denser placement of leachate collection pipes, will add to the cost of a landfill. However, these changes may be far less expensive than constructing effective liners.

3. To avoid the initial cost and ongoing maintenance requirements of pumping leachate, leachate can be collected in a lined holding pond that is constructed downhill from the landfill. In this impoundment, the leachate could be allowed to evaporate as much as possible.

Landfill Gas - Landfill gas will be generated as solid waste decomposes. The amount and chemical characteristics of landfill gas is a function of the type of solid waste placed in the landfill and the chemical/biological conditions maintained in the mass of solid waste in the landfill. Landfill gas is primarily a mixture of methane and carbon dioxide produced by the decomposition of the organic matter in the municipal solid waste. Landfill gas (methane) is highly flammable and poses a risk of explosion on and off site. Landfill gas can migrate through soil as the pressure increases in the landfill due to gas buildup.

Gas management is generally required at secure landfills as the accumulation of solid waste placed in the landfill increases. At controlled dumps, there should at least be gas monitoring to determine if dangerous amounts of gas are being released and migrating to locations where it can cause problems.

A low-cost design to handle landfill gas consists of buried vertical perforated pipes, using the natural pressure of the gas to collect and vent at the surface. This is called a passive collection system. More costly active collection systems utilize a buried network of pipes and pumping to collect the gas for flaring or combustion to generate electricity. There are general conditions that should exist to justify the capture and use of landfill gas. Fundamental to all this is the fact that there needs to be sufficient landfill gas available to justify the expenditure of installing an active gas system where the gas is captures for its energy value.

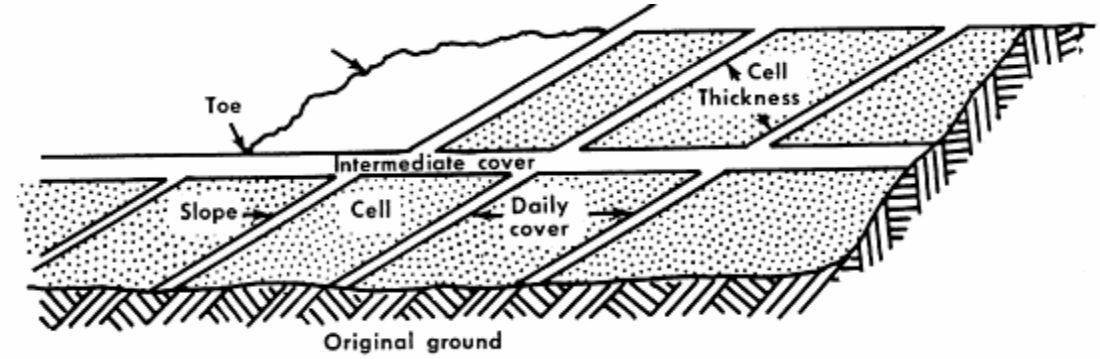
This generally requires that a landfill has at least 1,000,000 tonnes of solid waste in place to generate sufficient gas.

Access Security - Landfill access features such as fences and berms should be designed to restrict unauthorized access to the landfill and to keep out stray animals. Ideally, a fence, wall or vegetative hedge should be planted along the perimeter of the site. Such structures can also assist in catching paper or plastic materials that become airborne because of windy conditions.

A staffed gate should be the point of entry to the facility for vehicles and any waste pickers. Ideally, the gate should be equipped with scales for the weighing of vehicles as they enter and exit the facility. This provides a record of the tonnage of material entering the facility. Weigh scales are an essential element of a sound municipal solid waste management system since they provide critical information for planning purposes and for operational management of collection vehicles. However, as is the case throughout the world, the size of the landfill may determine the economic ability to support the installation of features such as truck scales. In the case of the small to moderately-sized controlled dump (less than 200 tons per day), calibrated tables of weight-to-volume for delivery vehicles may be used to provide an estimate of the quantity of materials brought to the disposal area. Some monitoring of the amount received is a crucial sound practice since it provides important information both to monitor the performance of the facility, to monitor the efficiency of the collection system and to plan future solid waste management practices.

Work Face Operations - It is useful to define and illustrate some common terms when discussing landfill operations.

A **cell** is the basic unit by which a landfill is developed. It is the general area where incoming waste is off-loaded from trucks, spread, compacted and covered. A basic cell consists of a base of synthetic or soil liner, compacted municipal solid waste and a compacted cover layer of soil. Cells range in height from two to three meters. Special cells in the landfill may be reserved for materials such as medical waste or construction and demolition debris. The dimensions of a cell depend on 1) the type of equipment being used to deliver, place and compact the solid waste and 2) the dimensions of the overall site.



Typical Landfill Lift Structure

A **lift** is the completed layer of compacted waste in the cell. Municipal solid waste is laid down in rows 25 to 75 centimeters thick. This layer is then compacted either by multiple passes of a manual roller or a mechanical compactor. A second layer of waste is then spread upon the first and subsequently compacted. The process is continued until the desired height of the lift is attained. As noted above, this ranges from two to three meters. The completed lift is covered with a layer of soil that is 15 to 30 centimeters thick when compacted. This layer of cover is called intermediate cover. This completed lift and cover material constitute a cell. Compaction increases the capacity of the landfill. Mechanical compactors achieve densities of 500-900 kilograms per cubic meter. However, smaller landfills in developing countries may not be able to afford solid waste compactors. Other equipment such as rollers or bulldozers may be used for this purpose. There will generally not achieve the compaction densities of compactors.

The **working face** is the length and width of the row in which the waste is being deposited. The overall intent of controlled operations should be to keep the overall size of the work face at a minimum. This will help to decrease overall costs and increase the ability to control environmental effects.

As illustrated in Figure 2, some landfills use multiple lifts. Thus, when one cell is completed, another is placed above it. This second level of cells is not begun until the first level is filled with cells at the same level. It is customary to stack cells into a final pyramidal structure. The final cell in the stack is covered with soil that is 60 centimeters thick when compacted. When stacked cells are employed, the final slope should be chosen to facilitate the runoff of precipitation while ensuring the stability of the structure. Examples of such a design from the prototype communities will be presented later in this manual.

To the degree possible, delivered solid waste should be dropped off at the working cell or work face. This requires the construction and maintenance of access roads to work face locations within the site. If this is not possible, tipping should occur close to the gate area and the load transported to the working cell by onsite vehicles or carts. In any case, the tipping and cell process must be actively manages if the cell construction is to be maintained at its smallest size. This is an extremely important element in operating effective landfill operations irrespective of the size of the facility. Observations at the prototype community disposal areas have shown that a lack of tipping location control creates a situation where waste becomes indiscriminately scattered throughout the disposal area with no means for controlling its effects.

Materials Recovery at Disposal Sites - Materials sorting at a landfill can be either an informal process through the activity of scavengers or formal if materials are separated for recovery or for composting. Generally, sorting and recovery should occur in a designated location away from the working cell. This helps to eliminate the basic safety conflict between the operation of mechanized equipment and informal scavengers. Activities such as recycling at the workface can work against the goal of keeping the workface area at a minimum size.

Access to a landfill should be restricted to trained personnel and municipal solid waste haulers. Landfill operations and machinery can pose dangers to untrained persons. Where waste picking is allowed or difficult to prevent, the process should be controlled as much as possible. If pickers nevertheless persist at landfills, licensing and cooperation between pickers and municipal staff can help to minimize problems. Allowing pickers access to secure facilities, and providing basic health services such as vaccinations for infectious diseases and tetanus, will reduce health problems. This approach has been followed in cities such as Bangkok, Cairo, and Seoul. Operating under a permit structure may provide greater control of scavenger activity by providing greater accountability to the landfill operations plan.

Construction - While construction is required for any new landfill site, it can also be expected that construction in some form will continue during the operation of the site. The amount and type of construction depends on the class of landfill and on physical conditions at the site. Construction will be required for:

1. Access roads
2. Erection of fences, gates, and the tipping area
3. Site preparation for the diversion of precipitation and the control of runoff
4. Installation of the leach ate and gas collection, treatment and monitoring systems
5. Administrative offices and other buildings at the facility
6. Preparation of the general working area, including: land clearing, grading, and excavation
7. Installation of liner

ANNEX 2 - WASTE GENERATION CAPACITY BUILDING

The process of solid waste management must begin at its point of generation. The direct actions of solid waste generators can have a major impact on the success of any solid waste management program. As a result, there are a number of procedures that government solid waste managers or community leaders need to be familiar with. Some of these are described below.

1. HOW TO INCREASE PUBLIC AWARENESS OF SOLID WASTE ISSUES

Basis - Good public awareness is very important in the success of any solid waste management program at all levels. Effective SWM programs are directly a function of the actions of solid waste generators and their willingness to pay for good services. Because of this, SWM programs must never stop the public education process. Waste generators need to clearly understand the consequences of their actions including those that directly affect the health and welfare of their families and neighbors. A comprehensive solid waste management programs should have a formal public awareness element where there is a direct attempt to influence public attitudes about the manner in which solid waste is managed.

Desired Result – Increased public awareness of solid waste management issues with an emphasis on the health effects of current practices and the benefits of effective ISWM programs

Recommended Procedures – Public awareness programs should be aimed at individual solid waste generators. For example, it is in the Dinas Kebersihan's best interest for people within their service area to understand solid waste management issues and the efforts required to deal with them. This is particularly important in the siting of new disposal areas or transfer stations. Government and community leaders should actively sponsor and support public awareness campaigns focused on SWM issues. The following are general procedures that may be utilized to increase public awareness of solid waste issues.

1. In developing a formal solid waste management program, a public awareness plan should be developed outlining the objectives of the public awareness programs and the means to accomplish the objectives.
2. At the government level, one individual should be responsible for public outreach and that element should be given a high priority in the overall SWM program.
3. Targeted campaign elements aimed at schools, civic organizations, women's groups, etc. are important.
4. Development of controversial facilities such as new disposal areas or transfer stations often require specific public information and consensus building efforts that are focused on the concerns and issues associated with those facilities.

5. Establishing a positive public image for a formal solid waste management program at the government or community level is important. This can be accomplished through well maintained and clean trucks and containers that are clearly identified as elements of a solid waste management program.
6. Positive developments in expanding or enhancing SWM in a service area should be well publicized.
7. There are various public information techniques and formats that have been successfully utilized in SWM programs. Some of these along with their advantages and disadvantages are presented on the following pages.

2. HOW TO GET RESIDENTIAL SOLID WASTE GENERATORS TO FOLLOW RULES AND ACT RESPONSIBLY

Basis - Effective solid waste management requires a degree of discipline and enforcement to assure that solid waste materials are properly managed. While a good solid waste manager recognizes the importance of educating solid waste generators about the environmental, health and economic benefits, a level of enforcement of reasonable rules and regulations may also be required to assure success. In many countries where effective SWM programs are common, one of the most meaningful factors has been the application and enforcement of laws, rules and regulations relating to solid waste or environmental management. For example, enforcement of litter laws can force the use of alternative ISWM processes as they are developed. In many countries, solid waste generators are not be given a choice between random dumping of their solid waste or participating in a formal solid waste management program. However, in locations where enforcement of existing laws and regulations is not practiced, it makes it more difficult for SWM programs to be completely successful.

Desired Result – Increased willingness to comply with improved community SWM standards and alteration of current practices

Recommended Procedures – The following are some of the important means for achieving the desired result.

1. Establish a public information campaign that directly relates current substandard SWM practices with environmental and health effects.
2. Develop and aim litter prevention campaigns to schools and children for maximum long term effect.
3. To the degree practical, promote laws, rules and regulations aimed at preventing littering and illegal dumping.
4. Establish a basis by which these rules and regulations can be enforced through fines or other mechanisms that make substandard practices a risk for generators
5. Work with community leader to establish standards for solid waste management within their community.
6. Promote community events aimed at cleanliness and litter collection. Such programs have the effect of making people realize that the causes of litter and random dumping can be controlled. They also create peer pressure on individual generators leading to greater participation in community based programs.
7. Provide incentives for community or village areas that are maintained to a good standard of cleanliness. Provide media coverage of these communities.

3. HOW TO SEGREGATE AND INDEPENDENTLY MANAGE UNIQUE WASTE STREAMS SUCH AS MARKET WASTE AND MEDICAL WASTE

Basis - Certain solid waste streams have unique properties that require or warrant their independent management. This could be due to dangerous properties that warrant special procedures for managing the materials to reduce the danger associated with them. For example, medical waste from hospitals and clinics can cause disease transmission to people that inappropriately handle this material. When medical and clinic wastes are simply dumped in with other waste forms, people who handle this waste such as waste collectors and waste pickers may not be aware of the dangers and disease transmission potential associated with the material. Because of this, effective ISWM programs require the identification of these waste sources and the development of processes to manage them. This may include independent collection and treatment prior to the disposal. In some countries, private medical waste management services are provided where this material is collected and disinfected through incineration or another such disinfection process prior to disposal. Similarly, in some countries, medical waste generators are required to treat or disinfect their waste with on-site systems prior to integration into the comprehensive SWM program. In areas where there is a high concentration of industry, similar approaches are taken in managing hazardous waste.

There are other waste streams with beneficial properties that should also be identified and managed independently. For example, highly organic waste derived from market areas can provide good material for compost operations. Diverting this type of waste to such a beneficial use reduces the amount of solid waste that would otherwise be managed through a formal solid waste management program. Importantly, it would significantly reduce the amount of solid waste reaching disposal areas with the resulting effect that the capacity of these sites will last longer.

Desired Result – Implementation of independent processes to manage waste streams with unique properties including both those with dangerous as well as beneficial properties.

Recommended Procedures - The following are some of the important means for achieving the desired result.

1. During the needs assessment, determine any sources of waste with unusual dangerous characteristics including medical clinics, hospitals, industrial waste, etc. The assessment should also include the identification of market waste sources for potential application of compost processes.
2. Determine current practices for managing medical and clinic waste. Promote local programs and legislation aimed at managing medical waste in a responsible manner.
3. Until such time as programs are available for the independent management of dangerous materials such as medical waste, educate waste collectors and disposal area workers concerning the dangerous properties of these materials.
4. For management of materials with beneficial properties, assess the feasibility of alternative processing including composting of market waste.

Public Communication Techniques

Technique	Features	Advantages	Disadvantages
Briefings	Personal visit or phone call to key officials to announce decisions, provide background information, or answer questions.	Provides background information. Determine reactions before an issue goes public. Alert key people to issues that may affect them.	Requires time.
Feature stories	In-depth story about the siting study in newspapers or on radio and television.	Provide detailed information to stimulate interest in the siting study, particularly at key junctures such as evaluating alternative sites or selecting a preferred site. Often used prior to public meetings to stimulate interest.	Newspaper will present the story as editor sees fit. Project component has no control over how the story is presented, except to provide full information.
Mailing out key technical reports or environmental documents	Mailing technical studies to other agencies and leaders of organized groups or interests.	Provides full and detailed information to people who are most interested. Often increases credibility of studies because they are fully visible.	Costs money to print and mail. Some people may not read the reports.
New conferences	Brief presentation to reporters followed by question and answer period, often accompanied by handouts of presenter's comments.	Stimulate media interest in a story. Direct quotes often appear in television/radio. Might draw attention to an announcement or generate interest in public meetings.	Reporters will only come if the announcement is newsworthy. Cannot control how the story is presented, although some direct quotes are likely.
Newsletters	Brief description of what is going on in the siting study, usually issued at key intervals for all people who have shown an interest in the study.	Provide more information than can be presented through the media to those people who are most interested. Often used to provide information prior to public meetings or key decision points. Also maintain visibility during extended technical studies.	Requires staff time and money to prepare, print, and mail. Style of presentation can do a lot of harm – either too simplistic or overly technical or full of jargon.
Newspaper inserts	Much like a newsletter but distributed as an insert in a newspaper.	Reach the entire community with important information such as project need and alternative sites being considered. Is one of the few mechanisms for reaching everyone in the community through which you can tell the story your way.	Requires staff time to prepare insert, and distribution costs money. Must be prepared to the newspaper's layout specifications. Potential negative reaction to use of public funds for this purpose exists.

Technique	Features	Advantages	Disadvantages
News releases	Short announcement or news story issued to the media to get interest in media coverage of the story.	May stimulate interest from the media. Useful for announcing meetings or major decisions or as background material for future media stories.	May be ignored or not read. Cannot control how the information is used.
Paid advertisements	Advertising space purchased in newspapers or on radio or television.	Effective for announcing meetings or key decisions. Story presented the way you want.	Can be costly. Radio and television may entail expensive production costs. to prepare the ad. Potential negative reaction to use of public funds for this purpose exists.
Presentations to civic and technical groups	Deliver presentations, enhanced with slides or Viewgraphs, to key community groups.	Stimulates communication with key community groups. Can also provide in-depth feedback.	Few disadvantages except some groups may be hostile. Requires time.
Press kits	A packet of information distributed to reporters.	Stimulates media interest in the story. Provides background information which reporters use for future stories.	Has few disadvantages. May be ignored. Cannot control how the information is used.

4. HOW TO PROMOTE THE 3R (REDUCE/ REUSE/ RECYCLE) APPROACH

Basis - Inherent to all of the ISWM processes is a need to reduce the quantity of solid waste that requires final disposal. In many countries, waste picking occurs throughout the collection process as well as at disposal sites. Waste pickers seek to recover materials with any value so that it can be sold to brokers or to manufacturers who can utilize the material for producing new products.

An effective ISWM public education program should include elements that are aimed at teaching waste generators about the need to reduce the quantity of solid waste that they generate. While many people will recognize the benefits of solid waste diversion, considerable effort is usually required to optimize waste diversion. In an effective ISWM program, waste streams components with strong diversion potential should be identified and an effort made to implement the diversion. For the most part, the recovery value of any solid waste components is defined by available markets for the material. Currently, metal containers are retrieved from solid waste collected in Banda Aceh. This occurs because there are brokers available who will buy the material and pay approximately 5000 Rupiah per kilogram to the collector.

Desired Result – Reduction in the amount of solid waste generated and increase in the amount of solid waste diverted to beneficial use

Recommended Procedures - The following are some of the important means for achieving the desired result.

1. Develop public information campaigns aimed at promoting the procedures and benefits of 3R processes.
2. Promote processes aimed at reducing the amount of solid waste generated.
3. Evaluate existing markets for recovered materials to determine which items are commonly collected and the payments for collected material.
4. Determine ways that assistance can be provided to markets to increase the amount of material recovered.
5. Evaluate various ways that materials of value can be recovered during collection and disposal.
6. Work with waste pickers to improve their working conditions and enhance their ability to recover materials of value.
7. Recognize that waste collectors will separate out materials for sale as they collect solid waste. Do not object to this process so long as it dies not affect the performance efficiency of the collection process.

5. HOW TO DETERMINE THE AMOUNT OF SOLID WASTE THAT MUST BE MANAGED

Basis – Estimating the quantity of solid waste that must be managed is important in designing the infrastructure and means by which it is managed. For example, the number of trucks needed for collection or transfer and the size of a disposal area is a direct function of the amount of solid waste that must be managed. Large scale solid waste management programs often have the means to directly measuring the amount of solid waste through weighbridges that physically weigh the waste as it is received at a SWM facility. However, in small population centers and rural areas such as those in Aceh Besar and Aceh Jaya, the means for directly weighing solid waste is not available. As a result, unit generation rates are often used for estimating the amount of solid waste generated. Experience in Indonesia has shown that, as a good rule of thumb, residential solid waste generators will produce about 2.2 liters of solid waste per person per day of solid waste per day. Similarly, estimates can also be made of the quantity of solid waste generated from commercial and production sources. In using population statistics to estimate solid waste generation, it's important to note that individual ISWM components should be sized based on their directly contributing population. For example, the development of the community-based system should be defined by its existing contributory population and an estimate of future population growth in the community. This helps assure that sufficient infrastructure is available to serve for a reasonable design period. At a larger scale, the development of new government sponsored disposal sites in various locations in Aceh Besar and Aceh Jaya, for example, must also be sized in accordance with the current and anticipated contributing population as well as the magnitude of other waste streams (markets, etc.) that will reach the facility.

Desired Result – Assessment of the amount and type of solid waste to be managed by any ISWM process element

Recommended Procedures - The following are some of the important means for achieving the desired result.

1. Determine the population to be served by SWM infrastructure elements such as the total population contributing solid waste to a disposal area or the total population to be served by a collection system. Population estimates can also be used to determine required capacity at individual elements such as collection system TPS or transfer stations.
2. Project future solid waste management needs by estimating the anticipated growth in population that will contribute solid waste in the future. Historical population growth can serve as a good basis for projecting population growth in the future.
3. Specific contribution from solid waste sources such as markets or commercial areas should also be determined. The amount of solid waste generated from these sources can be estimated by observing the amount of solid waste generated over a pre-selected period of time to get a representative assessment of the quantity of waste generated.
4. Based on the quantity of solid waste generated, the function and performance of individual SWM components such as trucks can be evaluated to determine the number of trucks required for serving a service area population.
5. After implementation of a SWM program, the amount of solid waste managed should be regularly monitored to verify original quantity estimates and to determine future infrastructure needs.
6. At government facilities of such as disposal areas, and attention be made to evaluate the amount of solid waste received from different jurisdictions. This can be important in ongoing program planning and may also serve as a basis by which cost sharing can occur. In many landfills in industrialized countries, disposal areas are equipped with weighbridges that allow for computer-based records to be kept of solid waste received. Such information can be important in determining the amount of disposal or a capacity that is being used over a period of time as well as determining the overall efficiency of a collection system by monitoring the amount and schedule of delivery of solid waste to the disposal facility.

ANNEX 3 - PRIMARY COLLECTION CAPACITY BUILDING ELEMENTS

The primary collection process is that portion of the solid waste management flow path where individual generators deliver their solid waste to a secondary collection location. The secondary collection point may be a fixed TPS bin or container located at a designated site in a residential, commercial or market area. Normally, the solid waste generator is responsible for getting the waste to the secondary collection location. This is usually accomplished by having a member of the household directly carry the waste to the secondary collection point on a regular and periodic basis. Alternatively, private individuals or waste collectors employed by the community may provide a door-to-door collection service for a small fee to transport the solid waste to the collection point. Solid waste generators at markets are also responsible for carrying their waste to a collection point or dealing with a waste collector who will carry it to the collection point for them.

In primary collection, the responsibility for the solid waste generated remains with the generators. Once the solid waste is collected into the secondary collection and transfer system, it becomes the responsibility of the government-sponsored program.

HOW TO DEVELOP A COMMUNITY LEVEL PRIMARY COLLECTION PROGRAM

Basis - Throughout the strategy employed in developing an effective ISWM program, public education and enforcement are important and necessary elements. In a primary collection program, solid waste generators have the direct responsibility for getting their solid waste to transfer or collection points where the government based programs will take charge of the material. The optimum manner by which primary collection could be developed would be through door-to-door collection services by a government-sponsored program as is the case in many sections of Banda Aceh. However, this is much more costly than transfer point approaches that utilize fixed TPS or containers. Formal government-sponsored door-to-door collection may not be practical for community, housing, and roadway configurations found throughout Aceh Besar and Aceh Jaya. Sustainable best practices for primary collection are defined in Annex 1 of this Action Plan. Individual communities should be prepared to make decisions as to the manner in which primary collection is undertaken. The community's involvement could be as simple as locating collection points within the community or through sponsorship of a door-to-door collection scheme where individuals either working his private contractors or employed through the community provide the transfer of solid waste from the generator to the collection points.

Desired Result – Development of an effective community-level primary collection program

Analysis and Recommended Procedures – There is considerable experience throughout the world in the development of community-based collection systems. Community-based collection initiatives usually arise when a community collectively recognizes that they have a need to autonomously manage their solid waste to improve

conditions within the community. These local initiatives will normally come about as a result of three categories of activity including:

1. A group of households acting as a community collectively recruit a person for primary collection and agree to a minimum fee and pay the waste collector individually,
2. A group of households acting as a community actively manage the collection system and arrange for collection of fees and payment to the waste collectors,
3. A small contractor starts a collection service as a business by making an investment and then marketing the service to individual households in the community.

Some of the fundamental issues that should serve as guidance to community-based systems include the following:

1. Willing participation by all members of the community can't be assumed from the outset. Strong motivation might be required with some assistance through public education and community pressure.
2. Education and public awareness are important in affecting the attitudes that may be influenced by the health and environmental benefits of an improved waste management system.
3. Close coordination between the primary collection system and a government-sponsored secondary collection and transfer process needs to be maintained at all times.
4. Institutional and financial sustainability is crucial if the system is to be successful. Community leaders need to recognize that greater convenience involving door-to-door collection of solid waste usually involves increased costs. The willingness and ability of community members to pay these costs may influence the decisions made in-house solid waste is brought to the secondary collection points.
5. There needs to be a clear understanding of the community composition and social structure. This requires that the poorer or weaker segment of the community be provided with services that do not isolate them from the program.
6. Viable technical choices need to be made as to the appropriate technologies that will be utilized even at a low technology level (hand carts, etc.) which is often the case in community-based primary collection programs.

At the community level, there are usually three different groups of participants that may be involved in primary collection including: 1) households that generate the waste and possibly transport it to community collection points, 2) waste collectors, and 3) organizations such as a community-based organization or NGOs that may assist in organizing the program in the first place. The process by which a community can organize its effective solid waste management program is similar to the process that the Kabupaten will take in organizing its solid waste functions. Initially, a basic needs assessment needs to be completed that defines the procedures and equipment that will be utilized. Common technical alternatives include the development of collection points at various locations within the community or the development of a collection service that will pick up solid waste at the point generation. While the latter approach is more convenient for residential generators, it is more costly. The use of fixed collection points requires that they be strategically located in accessible locations that will be convenient for generators to bring their waste of. Collection points may consist of mobile containers or fixed structures.

In many community-based primary collection programs, individual micro-enterprise contractors may provide door-to-door collection on a fee basis. This is an excellent way to collect solid waste in a community so long as the service is affordable. Community leaders may attempt to organize door-to-door collection depending on community member

willingness to pay for the service. If it is developed, community leaders should closely monitor the performance of the collection service to assure that it is provided in a timely and effective manner.

There are a number of other elements that may be included in a community based solid waste management program. As part of the educational process and for the benefit of the community, periodic cleanup days should be planned. On those days, the community collectively gets together in an organized fashion to provide community cleanup including the collection of solid waste in drains and on roadways or vacant lots. This will foster both the ownership of the solid waste management program as well as improved community morale and cleanliness. To the degree possible, community leaders should solicit the active involvement of youth groups or other social organizations that can provide additional sponsorship of the cleanup activity.

Community leaders may also, in conjunction with NGOs, promote compost and recycling programs in a scale appropriate for the community. This can include the promotion of backyard composter applications or the independent collection of materials with recycle value.

If the community will then be responsible for transferring solid waste placed at the collection points to a disposal location, it is important that these locations be closely monitored to assure that they have probably used and that they are kept clean and service. The frequency at which solid waste is transferred from the collection points should be determined by the amount of solid waste that is accumulated at the sites on a regular basis. While the community leaders can make initial estimates of the frequency of cleaning, close observation of the actual amount of solid waste received may affect the frequency of transfer.

If a community-based collection program is organized, a minimum standard of performance should be developed to assure that the collection process becomes routine and regular and that waste generators can rely on its service.

Experience a shown across the world that the development of community-based collection programs can be done in an effective manner that provides a good quality service to residential waste generators. However, that experience is also shown that common issues must also be addressed. Some of these common issues and the manner in which to overcome them are shown in the following tables:

Primary Collection Issues and How to Address Them

WILLINGNESS TO PARTICIPATE	
Issue	**How To Address It**
People don't see the relationship between waste collection and improved health benefits.	Educational promotion of health and environmental benefits to community groups should be emphasized
Transfer points are to far away.	Supply house to house collection services or create additional collection points
Secondary waste collection and transportation is unreliable.	Regular and timely collection of waste by the government. Agreement should be negotiated between the community and government solid waste managers on level of service.

Lack of communication between the community and the government-sponsored secondary collection and transfer program.	Close working relationship between the community and the government through consultation and involvement in the planning and design of the secondary collection system.
Individuals find that separation of waste and recycling is both time-consuming and unpleasant work.	Educating the community on the importance of collection and recycling with respect the health, environmental and social benefits.
Communities don't feel a sense of ownership towards a waste collection scheme in their area.	Community workshops on solid waste management involving all groups concerned with the collection process
Community members are often suspicious of waste operators.	Educate the public on the important roles of waste operators in waste collection from an environmental and health perspective.

COORDINATION WITH SECONDARY COLLECTION PROGRAM

Issue	How To Address It
Lack of transparency in roles, responsibilities and obligations.	Rules and regulations should be put in place and implemented so that the solid waste management services and schemes at the community level can be run effectively. Community groups must be informed about the government system role and responsibilities.
Local governments have elected representatives; Community groups have their own elected officers. Neither accepts the legitimacy of the other.	Creating a government level platform when both the Government officials responsible for solid waste and elected representatives of the community can come together and discuss the issues on community primary collection.
Uncertainty concerning the nature and level of assistance over time from the government. Community-based collection programs may collapse if a motivated member of the government management transfers or active community members move away from the community.	Essential for members who are moving out of the government office or community to pass on their knowledge and skills to their replacements before leaving.
Lack of clear two-way communication between the government and community groups concerning changes in the waste collection system	Provide clear written guidelines regarding issues such as the financial allocations to support the community waste collection program. Improve communication with a government by informing them of the waste collection activities taking place in a community including regularly scheduled cleanups.

FINANCE

Issue	How To Address It
Governmental units are unable to recover all the costs involved in solid waste management operations	Improve financial management to define full costs. Develop user charges as services improve. Change in method of payment for solid waste services.
Community groups or individuals may not see the need for centrally operated services such as regional disposal areas.	The community needs to be educated on the importance of an integrated solid waste management system and the adverse impact of poor disposal practices including those at disposal sites away from the community.

Community groups do not have access to operational finance from the government.	Community-based systems are in the interest of the government. Explore whether finance can be made available at the community level for effective solid waste services.
The community-based collection schemes are not able to collect adequate fees regularly.	Provide fee collectors with incentives such as ownership of recyclable items given by household that can be resold, or receiving a percentage of the fees collected. The collection of fees could also be entrusted to respected community members rather than waste operators. Accounts must be transparent.

ABILITY OF THE POOR TO PAY

Issue	How To Address It
Waste collection is a low priority compared with other household needs particularly among the poorest segment of the community's population.	Address other issues first which are not directly related to waste collection programs. Expenditure on food, housing, clothing, electricity and education receives higher priority. Confidence of the community members may be gained by focusing on other activities related to welfare and health such as vaccination programs or celebration of a cleanliness week to create awareness of solid waste collection issues. A sense of ownership is promoted through small payments that may not be reflective of or recover full costs.
Some households cannot afford to pay the charges for a community-based collection service.	Individuals pay a direct service fee to the waste collector on either a daily or weekly basis. This is inappropriate in low income areas which may be surviving in the informal economy where wages are unlikely to come systematically at the end of the month. Some Indonesian SWM fees are based on the amount of waste collected or on the income level of the household.

RELIABILITY OF WORKERS

Issue	How To Address It
Lack of incentives available to waste collectors to do their job properly.	Reward incentives can be provided to operators. Rewards can include collecting recyclables from sorted household waste or efforts leading to greater social acceptance by the community. Part-time employment may also be provided to waste collectors so that the waste operator will also have opportunities for other works. To control performance of waste operators, payment to operators should be performance-based where they are by round instead of monthly.
Low status and lack of respect for waste collectors from all levels of society from the community through to the national government.	The nature of this work is considered to be unpleasant and dirty. Citizens need to be educated on the importance of waste collectors. Promotion campaigns on the value of waste collectors involving senior government officials. Provide identity cards to waste collectors, giving them a more official role. Official introduction of waste collectors to residents by locally respected individuals can help.

Waste collectors work in poor conditions and are exposed to many health hazards	Provide good equipment and facilities as well as appropriate personal protection equipment such as gloves.
Waste collectors are not involved in the decision-making process.	Involve waste collectors in meetings such as NGO workshops from the start to promote better commitment and more motivation.

LOCATION AND SPACE FOR COMMUNAL BINS

Issue	How To Address It
Lack of space for storing the accumulated waste before it is transferred.	Collaboration between those involved in implementing the collection process and community leaders in the identification and allocation of space. Campaigns to educate the public to use collection points or bins properly (This can result in less waste strewn around the bin).
Residents do not want solid waste storage in the vicinity of their houses.	Waste placed in garbage enclosures (2 m wide, 3 m high) so that waste is not visible. Joint monitoring with the community of conditions around collection bins. Provide reliable service for house to house collection of waste.
Communal bins are not well managed which creates a nuisance for the public or residence.	Community level forum in which the community and government solid waste managers discuss how to improve communal collection point/bin systems and the collection process.

EQUIPMENT

Issue	How To Address It
Lack of appropriate tools and equipment for the collection of waste.	Purchasing additional equipment such as brooms and shovels to improve the effectiveness and efficiency of the waste collectors. Consult with solid waste collectors during the design and pilot testing of new equipment.
Lack of appropriate equipment for transferring collected wastes.	Review and optimize loading/unloading procedures at the transfer points.
Health and safety of solid workers is often overlooked while choosing equipment	Equipment must be selected and maintained keeping in mind the health and safety of the collection workers. Purchasing protective clothing such as boots and gloves are necessary especially if sharp objects and infectious wastes are collected. In addition, uniforms create a team spirit and pride among the waste operators. They also provide a form of identity so that households can easily spot waste operators from a distance.
Lack of repair and maintenance of equipment	A repair and maintenance system must be put in place before equipment is purchased and put into service.

TRANSFER AND TRANSPORTATION OF WASTE	
Issue	**How To Address It**
There is a lack of cooperation and coordination between the primary collection program and the subsequent collection and transfer by the government.	A timely, reliable and regular secondary waste collection service is vital for effective primary waste collection. Active coordination and enforcement by the government to improve links between primary and secondary collection is important
Waste pickers create a nuisance at the transfer points	Community monitoring in the area where waste pickers sort through the wastes to ensure that remaining waste is placed back in the TPS bin or container after sorting.

ANNEX 4 - SECONDARY COLLECTION AND TRANSFER CAPACITY BUILDING ELEMENTS

1. HOW TO OPTIMIZE TPS OR CONTAINER PLACEMENT AND SERVICE

Basis - If door-to-door collection is not utilize for solid waste collection, fixed TPS or container locations are required for waste generators or primary waste collectors to bring their waste materials to a location that will serve as the interface with the government-based secondary collection and transfer program. So as to prevent random dumping, TPS or containers need to be conveniently located for effective service. Solid waste generators should not have to carry their solid waste more than 200 meters to a fixed TPA or container location. In addition, these collection sites should be at a location where secondary collection vehicles can easily service them. Access characteristics will depend on the design of the collection point. For example, the use or arm-roll containers provide an effective means for accumulating solid waste for secondary collection. However, access to these containers must consider the manner in which container is drawn onto a service vehicle. In addition, there must also be sufficient room to allow the placement of an empty container at the time that a full one is retrieved.

In those areas where the quantity of solid waste collected does not justify the use of arm-roll containers, fixed or small container collection units can be utilized. Solid waste collected at these locations may need to be manually picked up and placed in a collection dump or fixed bed vehicle. Because of the time required to manually transfer the solid waste and clean up the location after collection, care needs to be taken that the collection vehicle will not impede traffic during the time that the collection process is occurring.

Desired Result – Increased knowledge concerning the placement and maintenance of TPS collection points

Analysis and Recommended Procedures – The following are some of the important means for achieving the desired result.

1. Primary system collection points should be determined based on the specific characteristics of the residential areas to be serviced.
2. Sufficient collection point should be established so that waste generators do not have to carry their solid waste more than 200 meters.
3. At a minimum, collection points should be located at sites that can be easily serviced by secondary system collection vehicles. These sites should be readily accessible by solid waste generators or primary collection waste collectors.
4. TPS or container locations should be selected that do not cause traffic back-up at any time that they are being serviced.
5. The collection points should be closely monitored to assure that solid waste is collected frequently enough so that the material does not spill outside of the TPS or container. This requires close and regular coordination between community leaders and government solid waste managers responsible for the secondary collection program.

6. Solid waste managers should monitor the performance of secondary program waste collectors to assure that they are performing their functions effectively and to a standard level of performance. This should apply to the manner in which waste is collected and how the collection point is cleaned as a result of the collection process.
7. Collection points should be monitored to assure that waste pickers do not create a mess when searching for recoverable materials. Solid waste managers, in conjunction with community leaders should work with waste pickers to assure that they return non-recyclable waste materials to the TPS or container after sorting.
8. When required, TPS and containers should be maintained (cleaned, painted, etc.) to keep them from deteriorating.

2. HOW TO DEVELOP OR EXPAND A SECONDARY COLLECTION/ TRANSFER PROGRAM

Basis - The number of people and the type and quantity of equipment required for secondary collection is a function of a number of factors including:

1. The amount of solid waste to be collected
2. The number of collection/transfer locations
3. The unit productivity of collection crews
4. The travel conditions (roads, traffic, etc.) along routes that trucks must travel during the collection process and during the transfer of collected waste to a disposal location.
5. The distance between collection points
6. The type of collection point used (container, TPS, etc.)

If done in the correct manner, the solid waste management master plan should evaluate the existing specific conditions of the collection service area to accurately define the required staff and equipment assets to achieve an effective level of service. If sufficient funds are available to put these assets into service, the governement solid waste manager should then be responsible for making sure that the secondary collection service is performed effectively and that its effectiveness is sustained.

Desired Result – Understanding how to define the collection assets (equipment and people) required for an effective secondary collection and transfer program

Analysis and Recommended Procedures - The following are some of the important means for achieving the desired result.

The Solid Waste Master Management Plan will identify viable collection options to consider for optimizing costs and productivity of the secondary collection process. This will be done by evaluating a number of factors including:

1 Route structure over which the trucks will travel for collection including a consideration of:
   a. Random solid waste accumulations along roadways
   b. Door to door collection
   c. Communal container stops with small containers that can be directly lifted onto the truck
   d. Communal stops with fixed TPS
   e. Larger communal container stops with arm-roll containers

2 Fixed routes should be established that are based on achieving regular and efficient collection of solid waste from all required collection points.
3 Vehicle size and type that will be used
   a. Small (hand cart, mini-truck, etc.)
   b. Slow moving such as tractor and trailer
   c. Fast moving and offloading such as open dump trucks or rear loader compactor trucks
   d. Fast moving but fixed bed with manual loading and unloading
   e. Container (roll on, mechanical arm for carts, etc.)
4 Crew size and manner of loading/unloading trucks
   a. Vehicle productivity more important in the overall cost than worker productivity
   b. Arrange crew size to optimize vehicle productivity (5-person crew may be lower cost/ton than 4-person crew since larger crew could load vehicle faster and optimize vehicle productivity)
   c. Facilitate method of loading (Time required to manually load and unload trucks significantly affects the vehicle productivity)
5 Length of shift
   Arrange shift length to get full loads in collection vehicle for transport to disposal or transfer sites
6 Number of shifts
   a. Two shifts may have lower costs than one shift by getting more productivity per vehicle
   b. Need to consider change in drivers and time required for maintenance/repair in addition to the time that vehicles is actually involved in collection and transport

Sustainable best practices for solid waste collection that may be applicable to Aceh Besar and Aceh Jaya are defined in Annex 1 of this report. This includes the criteria process by which a needs assessment can be completed at both the government and community levels.

3. HOW TO MONITOR AND MAINTAIN THE EFFICIENCY OF A SECONDARY COLLECTION PROGRAM

Basis - Once established, secondary collection should be a routine function within a fixed geographical service area. The secondary collection process should be continually monitored by solid waste managers to maintain its overall efficiency. Fixed routing should be utilized to establish a regular pattern of service delivery and schedule. Periodically, changes may be required in the function and configuration of a secondary collection system as a result of demographic changes such as development of new housing areas or growth of market areas. This may require a modification to the fixed routing structure by which collection crews service the collection points.

Experience is shown that there are many reasons for poor secondary collection performance including:

1. Poor Labor Management and Supervision,
2. More collection staff are necessary
3. Inadequate cooperation from waste generators in terms of collection schedules and waste placement practices
4. Inappropriate type and size of collection vehicles and equipment
5. Poor route structures for the secondary collection service

6. Poorly maintained collection points (TPS, containers, etc.)
7. Failure to optimize vehicle productivity by selecting inappropriate crew size and shift duration
8. Too few or poorly designed communal containers
9. Long vehicle downtimes due to poor or equipment preventative maintenance and repair
10. Long travel times to disposal sites coupled with lack of transfer stations
11. Poor driving conditions at disposal sites that cause vehicle and tire damage

Desired Result – Increased knowledge by solid waste managers about how secondary collection system efficiency can be maintained or improved

Analysis and Recommended Procedures – Management of any operation requires that reasonable but effective standards of performance be established and conformance to those selected standards be monitored. The following are some of the important means for achieving the desired result:

1. Secondary collection system routing should be designed based on the specific conditions that exist in the service area.
2. Secondary system collection routing should be planned and designed for optimum collection point coverage.
3. Solid waste managers should regularly review the productivity of collection crews. The should involve periodic observation of their performance in the field as well as a review of any records of performance such as the time that may be logged at disposal sites for collection vehicles.
4. Sufficient backup equipment and staff should be available to maintain the efficiency of the collection process in the event that collection vehicles break down.
5. Collection crew leaders should be required to maintain basic records as to collection performance. These records could include a simple log of times when certain activities occur such as the times when a collection vehicle leaves a collection route to transport solid waste to disposal areas.
6. At any time when there is a change to collection routing or the number of collection stops, a solid waste manager should review the performance of collection crews.

4. HOW TO SELECT AND MAINTAIN EQUIPMENT FOR SECONDARY COLLECTION AND TRANSFER

Basis - The use of solid waste compactor trucks and other form of mechanized equipment adds to the efficiency on a secondary collection and transfer program. However, it does so at a higher cost than may be sustainable in the service area. In industrialized countries where the cost of labor is high, more sophisticated collection equipment may be economically justified as a result of its decreased reliance on manual labor. However in many countries where labor is less costly, as is the case in Indonesia, the use of equipment that makes greater use of manual labor is often employed. Open body dump trucks are in example of such vehicles. In the area typical of Indonesia, there needs to be a balance between the efficiency of mechanized equipment utilization and the lower cost of manual labor. Secondary collection programs that make use of extensive manual labor such as in the use of fixed bed trucks have less efficient collection but they may be more affordable for the region. For example, a dump truck that brings solid waste to a disposal location can be offloaded in a short period of time when compared to a truck that must be manually unloaded. Because of this, the dump truck can spend more time actually collecting solid

waste and servicing transfer points. This can significantly affect vehicle productivity. If the cost of the secondary collection process is the prevailing factor rather than the overall efficiency of the process, fixed bed trucks may be warranted. However, more trucks may be required to provide a reasonable service level within the collection service area.

Desired Result – Increased knowledge on how to decide what type of equipment is necessary for secondary collection and how that equipment can be maintained for its most effective productivity and life expectancy.

Analysis and Recommended Procedures – The following are some of the important means for achieving the desired result.

1. Secondary collection and transfer equipment should be selected that is appropriate for the specific characteristics of the service area.
2. Traffic considerations and collection point characteristics are important in determining the type of equipment to be used for secondary collection.
3. Vehicle types should be selected based on overall cost and the availability of replacement parts when repairs are necessary. Equipment available from local sources should be given a preference because of the potential for greater support service.
4. To the degree possible, equipment purchased for a collection system should be of the same type and standardized. This will help in stocking spare parts as well is in the performance of repair and maintenance.
5. The condition of equipment should be regularly monitored to assure that it is performing effectively. This monitoring process should include the frequency of breakdowns so that equipment replacements can be planned.
6. Fiscal planning for the collection program should include the recognition that equipment will need to be periodically replaced. Typically, mechanized equipment such as dump trucks will reach a point where the cost of regular repair becomes too high and replacement is necessary. Managers responsible for monitoring the condition of equipment should closely observe the frequency and nature of repairs so as to plan for replacements.
7. Any equipment dedicated to a collection process should be incorporated into an effective preventative maintenance program to assure its maximum productivity and longevity. The following are some the considerations associated with effective preventative maintenance programs.

A critical issue in optimizing secondary collection and transfer is the maintenance of service infrastructure and equipment. In efficient programs, both reactive and preventative maintenance is practiced. The nature of mechanized equipment (such as collection trucks) is such that repairs (or reactive maintenance) will be periodically required. The time that it takes to make a repair can have a significant impact on the efficiency of a secondary collection program if sufficient backup equipment is not available. In an effective secondary collection program where redundant equipment is not generally available, the repair process must be as efficient as possible. Readily available spare parts for key vehicle components can help to keep repair time to a minimum. In any event an efficient secondary collection program recognizes the inevitability of breakdowns and works to repairing equipment as quickly as possible so as to return it to service.

Another characteristic of an effective secondary collection program is the practice of preventative maintenance. Preventative maintenance (PM) involves activities undertaken to prevent equipment breakdown. Experience has shown that the benefits of an effective preventative maintenance program include:

1. Increased unit availability
2. Reduced maintenance cost
3. Fewer large scale or repetitive repairs
4. Postponement or premature replacement of equipment

Clearly, the performance of preventative maintenance saves money in the long term and should be incorporated into a secondary collection process or any other solid waste management process that involves mechanized equipment. For example, the use of bulldozers and other such equipment at disposal areas should also include the adoption of preventative maintenance activities. Commonly accepted forms of preventative maintenance include

1. Inspection and tests
2. Routine upkeep PM tasks
3. Fixed and variable interval major PM tasks

Many of these tasks can actually be performed by the operators of the equipment. These tasks should be performed by equipment operators every day and checklists should be used to assure that the tasks are regularly done. Operator PM activities can include:

1. Pre-operating checks
2. Post-operations checks and service
3. Recordkeeping

5. HOW TO DETERMINE WHETHER TRANSFER STATIONS ARE REQUIRED

Basis - By their nature, TPS and container location become transfer points between the primary and secondary collection/transfer programs. However, depending on the location of final disposal locations, transfer stations may be required. The premise of transfer station development is that it is inefficient to have a secondary collection vehicle spend most of its service time traveling to and from disposal locations rather than in the collection process itself. Transfer stations are intended to allow smaller collection vehicles to bring collected solid waste to a location where it can be consolidated into larger vehicles for transfer to distant disposal locations. The relative location of disposal areas to the collection service areas generally determines the need for transfer stations. The analysis required to determine whether transfer station are necessary and cost effective can be accomplished during the solid waste management plan and needs assessment.

Desired Result – Increased knowledge concerning how to determine if transfer stations are required for effective secondary collection

Analysis and Recommended Procedures – A transfer system consists of a transfer station and a fleet of large capacity vehicles which provide more cost-effective long haul for solid waste so that the fleet of lower capacity collection vehicles can focus on the job of collection. In addition to increasing the overall efficiency of the solid waste collection program, transfer stations can decrease costs by up to 20 to 50%. In addition, transfer stations can also have environmental benefits by decreasing vehicle emissions and traffic to the disposal area.

In analyzing the need for transfer stations, it should be recognized that each type and size of collection vehicle has a different transfer breakpoint. The conditions of traffic and roadways over which vehicles must travel to disposal areas can also have an impact on the transfer breakpoint. Overall traffic speed influences of the time that is required to travel to the disposal area and therefore affects the overall savings that can be realized through use of a transfer station. As a good rule of thumb, transfer stations should be considered for any solid waste transport times from collection routes to disposal areas of over 30 minutes. One of the other advantages of transfer stations is that they allow disposal sites to be located in areas that are not in close proximity to population centers while maintaining the efficiency of the collection program. The transfer station creates an economy of scale for hauling of solid waste to the disposal area that decreases overall program costs. This also allows disposal areas to be developed that are more regional in nature. For example, larger disposal areas may be developed that serves more than one district and transfer stations can be used to optimize the time required to transport solid waste to those locations. Generally, one of the other advantages of the ability to consolidate waste flows through the use of transfer stations is the economy of scale that can also be realized at the disposal areas. Landfills should have a daily solid waste receipt of about 300 tonnes/day to fully utilize bulldozers and wheeled loaders. In addition, larger disposal areas serviced by waste transferred from a number of areas can also justify other infrastructure including roads, fences, weighbridges, gatehouses, utilities which are fixed costs that should be applied to larger waste quantities.

Some of the main design characteristics of transfer stations include the following:

1. Site of at least 2+ hectares
2. Good access to a road network which can carry large capacity long haul vehicles
3. Parking, maintenance and repair facilities for the transfer fleet
4. Weighbridges to record incoming amounts of solid waste possibly from different collection locations
5. Multi-level transfer building which allows unloading on top and loading on bottom

In designing a transfer station, the following will need to be closely evaluated:

1. Site and station layout for efficient traffic flow of both collection and transfer vehicles
2. Unloading system for receiving solid waste from collection vehicles
3. Loading method of transfer vehicles
4. Transfer vehicle style and material of composition
5. Discharge method from transfer vehicles once they have reached the disposal area

There are a number of configurations that are commonly used in the design of transfer stations. In some cases the collection vehicles will offload their content directly to the transfer truck or into a loading system for the transfer vehicle. This has the advantage of not requiring waste storage and therefore requiring less vector and odor control. In other cases, solid waste from a collection vehicle is dropped onto a storage platform or area from which it is loaded into the transfer vehicles. This allows the collection vehicles to spend as little time as possible at the transfer station before returning to their collection routes. It allows both the collection vehicles and the transfer vehicles to operate at their optimum schedules by buffering the waste receipt process for transfer through short term solid waste storage at the transfer station. It also provides a means by which any repairs to the transfer system can be undertaken without affecting the basic function of the collection vehicles.

There are a number of different types of trucks used for transfer. These include light-weight open top trailers for direct open top loading or compactor-compatible closed top trailers for use with for stationary compactor systems. (Examples of these are shown in Annex 8.) The choice of a transfer technology influences the costs of the transfer station. However, the use of higher technology with a higher capital cost could lead to lower overall costs for solid waste collection and transfer based on increased efficiency and savings associated with the basic collection process.

ANNEX 5 - DISPOSAL CAPACITY BUILDING ELEMENTS

Ultimately, an integrated solid waste management program attempts to divert as much solid waste away from final disposal as possible. However, disposal sites will always be required for that portion of the solid waste stream that cannot be diverted to some form of beneficial use such as compost production or recycling. Accordingly, one of the key elements that will be required in implementing and effective solid waste management for Aceh Besar and Aceh Jaya will be the development of new disposal sites or the improvement of existing sites. Some of the important issues that will need to be addressed are shown below.

1. HOW TO LOCATE NEW DISPOSAL SITES

Basis - In any country, locating new disposal sites is often the most difficult problem in developing effective solid waste management. While the public generally recognizes the need for good disposal areas, nobody wants them to be located near their residence or work place. While selecting new disposal sites on a good technical base is important, strong political will and consensus building is also required. Logically, the best site would be one with the desired physical characteristics located well away from any residential or commercial areas. It should also be located in an area where future land use development is not anticipated to encroach. Planning for new disposal locations must consider the future land use proposed for areas which may have the technical conditions appropriate for development of environmentally sound disposal. For example, in December 2003 BAPPEDA Kabupaten Aceh Besar issued its Revised Master/Spatial Plan (Revisi Rencana Tata Ruang Wilayah) for planned development of the economy, housing and infrastructure for the period 2005 through 2015. While the tsunami may have influenced the general direction of this plan, it provides guidance as to the planning direction of development in the region. This must clearly be considered in planning for new disposal locations. In addition, the construction of a new major highway through Aceh Besar is apt to affect development direction in the future which will also need to be considered in SWM planning both from both a waste generation and disposal location basis.

Desired Result – Increased knowledge in the procedures by which a new disposal site can be defined and developed

Analysis and Recommended Procedures – Organizations such as the World Bank have established criteria for development of SWM facilities including disposal areas. The following table presents typical World Bank criterion for disposal area development along with the specific issues that will need to be considered in Aceh Besar and Aceh Jaya.

Disposal Area Development Criteria Evaluation

WORLD BANK CRITERION	CONSIDERATION IN ACEH BESAR
Adequate land area and volume to provide landfill capacity to meet projected needs for at least 10 years.	Based on the landfill cell area required 2-4 hectares for the receiving area, 2-4 hectares for the leachate treatment and/or evaporation ponds, and additional 10% land for a landscaped buffer zone.
Site accessible within 30 minutes travel time. At distances greater than 30 minutes travel for collection operations to be economic, investment in either large capacity collection vehicles (5 tonnes per load or greater) or transfer stations with large capacity vehicles (20 tonnes or greater) would be necessary.	If appropriate, disposal sites should be located near population centers or transfer stations developed to maintain efficiency of the collection process.
Accessible from a paved public road which has an adequate width, slope, visibility and construction to accommodate the projected truck traffic	Should be located near good roads not on them. In Saree, refuse is dumped along the side of the road which is a hazard to human and environmental health.
A gently sloped topography with slopes which minimize the need for earthmoving to obtain the drainage slope of about 2%.	Along the east and west sides of the Kr. Aceh valley where it is moderately flat may be appropriate.
Groundwater's seasonally high table level is at least 1.5 meters below the proposed base of any excavation or site preparation.	With increased irrigation withdrawal from the Kr. Aceh groundwater levels have dropped considerably, however, the exact depth to groundwater is site specific. The water table is also low on the eastside of the Kr. Aceh where there are volcanic materials. Also at least, one meter of clay material should separate the landfill from the water table.
Availability on-site of suitable soil cover material to meet the needs for intermediate (minimum of 30 cm depth) and final cover (minimum of 60 cm depth), as well as bund construction (for the Cell method of landfill).	Alluvial material in the Kr. Aceh valley has considerable amount of clay in a variety of locations. On the West Coast, the soil is sandy, however, there are pockets of residual clay material adjacent to the limestone bedrock. In planning, assume1 cubic meter of daily, intermediate, and final compacted soil cover is needed for every 6 cubic meters of compacted refuse
None of the areas within the landfill boundaries are part of the groundwater recharge area for existing or an area of pending water supply development.	For the most, groundwater is recharge by rain in the mountains where there is up to 5 meter of rain a year. Development of landfills in low lying areas should not affect recharge.
No private or public drinking, irrigation, or livestock water supply wells within 500 meters down gradient of the landfill boundaries.	Irrigation systems are found throughout the Kr. Aceh Valley. Most villages get there water from wells, keeping the landfill away from villages will be important to keep the land fill develop away from village wells.
☐No environmentally significant wetlands should be located near the landfill site.	Wetlands, however, could be developed or considered for potential leacheate treatment.
No significant protected forests are within 500 meters.	Concern should be given to protective forest areas in the mountains along the east and west coast.

WORLD BANK CRITERION	CONSIDERATION IN ACEH BESAR
No open areas of high winds	Wind direction is well understood in Aceh Province. Areas of high winds are found along the coasts and in steep mountain valleys. Wind factors should also be considered in disposal area design.
☐No major lines of electrical transmission or other infrastructure (i.e., gas, sewer, water lines)	Power lines are located in many parts of the Kr. Aceh valley. Most power lines in tsunami affected areas will be moved.
No underlying limestone, carbonate, fissured or other porous rock formations	Karst limestone areas on the West coast should be avoided.
No underlying underground mines	No underground mines are present
No residential development within 250 meters from the perimeter of the proposed landfill cell.	This is site specific.
No visibility of the proposed landfill cell development area from residential neighborhoods within 1 km.	If not possible, landscaping or sight berms should be used to visually isolate the operation of the site.
No perennial stream within 300 meters downgradient of the proposed landfill development unless the stream can be diverted	Again, this is very site specific. However, the location of perennial waterways in each Kabupaten is one of the main criteria for site identification.
No siting within 3 km of a turbojet airport and 1.6 km of a piston-type airport.	Potential sites in proximity to Blang Bintang/Iskandar Muda Airport in Banda Aceh and Cut Nyak Dien Airport in Meulaboh should be avoided.
No siting within a floodplain subject to 10-year floods and, if within areas subject to a 100-year flood, must be amenable to an economic design which would eliminate the potential for washout.	On the West coast, flat areas away from the ocean are related to flood plains of streams. Flood locations must not be considered for disposal area locations.
Avoid seismic risk areas	This is very difficult due to the high seismic risk found in Aceh Province. Disposal area design must take this condition into consideration.
Avoid siting within 1 km of socio-politically sensitive sites	Areas in proximity to mosques, school, and villages should be avoided.

2. HOW TO DETERMINE LAND AREA REQUREMENTS FOR DISPOSAL

Basis – SWM planning must consider the development of facilities that will serve the desired purpose for a number of years. For that reason, an estimate of the amount of solid waste that requires disposal must be made to determine the land area necessary. Because of the time and resources required to develop new disposal locations, they should be planned to have sufficient capacity for a at least 10 years based on current and projected solid waste disposal rates.

Desired Result – Increased knowledge on how to determine how much land is required for solid waste disposal

Analysis and Recommended Procedures – The land area required for development of a disposal location is a function of a number of factors including:

1. The amount of solid waste to be received – This can be determined by population-based criteria (existing and projected population along with relevant unit solid waste generation rates) and a specific assessment of other sources such as commercial and market areas. Projections concerning the amount of solid waste to be managed at a new disposal location is commonly assessed during the needs assessment or development of the Solid Waste Management Master Plan which helps to define the technical requirements for the SWM program in the service area. Initially, the estimate of solid waste quantity can be based on unit generation rates for the solid waste generators. However, once a program is operating, data on the actual amount of solid waste received should be collected to provide more site specific information for future planning. For example, if data is collected on the amount of solid waste received at a disposal site, that data (amount of solid waste received each day or each year) can then be used in planning a new facility. This is one of the important reasons why large landfills have weighbridges to monitor the amount of solid waste received.
2. The desired life expectancy of the site – The size of the disposal area and the amount of waste received will determine the life expectancy of the site. If possible, the selected site should have a minimum life expectancy of 10 years based on the amount of waste to be received and the manner in which it will be operated.
3. The physical characteristics of the site itself – Site limitations such as property line configurations, topography or the existence of natural or man-made features such as roads or streams affect the area that will be available for disposal. In addition, portions of a site with steep slopes may also limit the developable location.
4. The manner in which the site is designed and operated – Providing good compaction of waste placed in the disposal area has a significant impact on the longevity of a site since less volume per tonne of solid waste will be consumed as the site is utilized. In addition, having the correct equipment to move the solid waste as it is placed is important in the developing cells which allow the disposal area to safely expand vertically thereby reducing the total land area required. Placement of the solid waste and disposal area using equipment such as bulldozers allows the material to be configured in progressive cells that will help to assure optimum space utilization and slope stability. Proper placement of solid waste in a properly configured disposal area will allow cells to be constructed as shown in a cell schematic shown in annex 1.

3. HOW TO DO AN ENVIRONMENTAL IMPACT ASSESSMENT OF A NEW DISPOSAL SITE

Basis - Developing a new disposal area requires a detailed investigation of its potential environmental impact. Given the close scrutiny that development of new disposal sites will usually entail, a complete and accurate environmental assessment is required. Public participation in the siting process (and in the resulting environmental assessment) will require this. The potential environmental impact is a function of a number of issues including:

1. The physical characteristics of the site.
2. The type of waste materials (hazardous or non-hazardous) to be placed in the disposal area.
3. The location and characteristics of possible environmental receptors (villages, etc.)
4. The design of the new facility (particularly those design features intended to mitigate potential environmental effects from leachate or gas).
5. The proposed operating plan for the new disposal area.

The Government of Indonesia requires all development projects including SWM facilities be studied to determine potential environmental impacts and to establish suitable mitigating measures. The scope of analysis depends on the magnitude and location of the project. In Indonesia, there are a number of required documents before a project can be implmented including:

1. AMDAL (Analisis Mengenai Dampak Lingkungan) - Environmental Impact Assessment
2. UKL (Upaya Pengelolaan [Kelola] Lingkungan Hidup) - Environmental Management Plan
3. UPL (Upaya Pemantauan Lingkungan Hidup) - Environmental Monitoring Plan

In addition, donors such as World Bank and USAID have their own requirements and regulations for environmental analysis, public hearings, and documentation. Normally, the scope of an environmental assessment is a function of the size and type of the planned facility. The Government of Indonesia has set minimum standards for solid waste transfer stations and landfills as shown below:

Government of Indonesia Threshold Criteria for SWM Projects Requiring Environmental Review (AMDAL or UKL/UPL)

SECTOR AND ACTIVITY	SCALE	AMDAL	UKL/UPL
Development of transfer station	Throughput (ton/day)	≥ 1000 tpd	< 1000 tpd
Final disposal with open dumping system		all	---
Final disposal in tidal area	Area or capacity	≥ 5 Ha or ≥ 5000 tons	< 5 Ha or < 5000 T
Controlled landfill system/sanitary landfill (non-hazardous waste)	Area or capacity	≥ 10 Ha or ≥ 10,000 tons	< 10 Ha or < 10,000 tons

References: Decree of the State Minister of the Environment No. 17/2001, dated 22 May 2001 and No. 86/2002, dated 28 October 2002; and Decree of the Minister of Settlements and Regional Infrastructure No. 17/KPTS/2003, dated 3 February 2003.
Ha = Hectares; km = kilometers; L/sec = Liters per second; tpd = tons per day

Given the probable scope of SWM projects in Aceh Besar and Aceh Jaya, full environmental impact assessments may not be required. However, environmental management and monitoring plans will, most likely, be required for new disposal areas and transfer stations.

Desired Result – Increased knowledge on the issues associated with the assessment of existing conditions and environmental impact of a new disposal area site.

Recommended Procedures – The following are some of the important means for achieving the desired result.

Environmental Impact Analysis (EIA) is a process of identifying, predicting, evaluating and recommending elements to mitigate the potential effects of a development proposal prior to major decisions and commitments. Development proposals requiring EIA could include the major road or commercial projects as well as environmental projects such as new disposal areas. An EIA shall be undertaken as early as possible in a project so that its results can be used in design and final planning. A comprehensive EIA normally consists of the following stages:

1. **Screening**: It is the responsibility of a regulatory authority to identify the need and the type of EIA required for the proposed project. (The Government of Indonesia has done that for solid waste projects as shown in the table above.)
2. **Scoping**: Scoping or design of the EIA study is important since affected stakeholders (public, local communities relevant regulatory authorities, etc.) should participate in this stage. This participation by the public and communities is an important element of the necessary consensus building required to implement a new disposal area.
3. **Assessing**: The key environmental issues identified in the scoping exercise should be evaluated according to commonly accepted assessing methods such as; mathematical modeling, metrics and professional judgment. The Government of Indonesia defines some of the methodology to be used in accomplishing environmental assessments.
4. **Mitigation Measures**: Mitigating measures for all significant environmental issues resulting from assessment should be defined to prevent or minimize their impacts. An environmental management plan may result from this stage to define the manner in which the environmental issue is managed throughout the project life.
5. **Monitoring**: There are two types of monitoring; compliance monitoring conducted by the regulatory authorities to insure project environmental activities compliance with regulations, and internal monitoring carried out by the entity responsible for the disposal area to monitor the effectiveness of the mitigation measures adopted in design and operations.
6. **Reporting:** The findings of the study should be prepared in a report and submitted to the regulatory authority for reviewing and approval purposes.

A comprehensive EIA study should cover the following phases in the development of a transfer station or disposal area:

1. Planning phase
2. Design phase
3. Construction phase
4. Operation phase
5. Closure phase
6. Contingency planning (The EIA should consider the situations that could occur is an accident or other situation resulted in a unexpected environmental impact.)

Each of the above phases should be evaluated for its major environmental components and potential effects including:

1. **Public health impact** – Public health may be potentially affected by a number of activities including the following:
   Construction phase - Local people may be exposed to high noise and dust levels during landscaping, access road and site preparation.
   Operations phase - In addition the following potential operational effects must also be evaluated:
   a. Gas emissions: Exposure of local people to gas emissions generated at the landfill site may affect on long term public health. In addition, landfill gas can be explosive in confined areas where an ignition source is present
   b. Noise: Local people may be exposed to high noise levels during unloading and compacting solid waste.
   c. Dust: Local people may be exposed to high dust levels during constructing new cells or as a result of truck traffic.
   d. Traffic accidents: Local people may be affected by traffic accidents during transportation of solid waste.

e. Litter: Local people experienced litter as a result of poor disposal area operations or waste picker activities..
f. Odor: Local people may experience odors resulting from poor landfill operations.
g. Infectious diseases: Animals and insects existing in the site may result in the transmission of diseases.

Closure phase

a. Gaseous emissions: the emission of landfill gas will continue well after a disposal area is closed and may affect on public health.
b. Landfill area surfaces may need to be maintained after closure to prevent exposure of solid waste and resulting odors.

2. **Occupation health and safety for workers –** There are a number of issues that need to be evaluated that can affect the health and safety of workers. The workers may be exposed to high noise and dust levels during landscaping, access road and site preparation. In addition there are a number of operational issues to be evaluated including:
   a. Noise: Workers at disposal areas may be exposed to high noise levels during unloading and compacting of the solid waste.
   b. Dust: the workers may be exposed to high levels of dust during new cell construction, unloading and covering solid waste.
   c. Gaseous emissions: Gas emissions from decomposing solid waste generated may affect the long-term health of workers.
   d. Hazardous waste: The probable existence of hazardous waste entering a disposal or transfer site may affect workers if this material is not managed in the proper manner.

3. **Socio-economic conditions associated with the project –** Socio-economic conditions resulting from the project must also be evaluated. These conditions can include the following:
   a. Construction phase
      i. Employment: Employment of local people should be considered during all construction activities. This should also be the case during the operation of the facility.
      ii. Visual impacts: the proposed facility may have a visual impact that affects nearby land use. This visual impact could result from the design of the facility as well as its operational practices in controlling litter and the dispersion of solid waste.
   b. Operation phase
      Business prosperity: The supply of spare parts and consumable products from local market sources is expected to enhance the local economy.

4. **Fauna and flora impact at the selected site –** The development and construction of the disposal area may have an impact on flora and fauna at the selected site. The following are some of the construction and operations phase impacts:
   a. Dust: fauna and flora species may be exposed to high levels of dust during excavation for landscaping and site development, site preparation and access road construction.
   b. Direct damage: Excavation and removal of the soil cover may lead to the destruction of vegetation and the disturbance of local fauna.

5. **Surface water and groundwater resource impact -** Water resources may be affected by a number of disposal area activities. During the construction phase, surface water and groundwater pollution may result from equipment maintenance (oil spills, etc.) or wastewater from workers. During operations, water resource damage could result from:
   a. Hazardous waste: The illegal dumping of hazardous wastes could cause groundwater and surface water contamination.
   b. Leachate from a disposal area can have a major impact on groundwater and surface water.

6. **Other unique site conditions such as archeological features -** Unseen archeological discoveries (if any) might be affected during excavation and site preparation.

After collecting the relevant available data to evaluate the above criteria, further data and information needs should be identified and generated. For disposal area projects the principal evaluations may include a physical assessment of water resources (Hydro geological study, etc.), public health (air quality and noise) and archeological evaluations. It is particularly important that potential groundwater pollution be assessed. At a minimum, a study should be conducted to identify geological and climatology information for the proposed site followed by modeling to investigate the groundwater pollution risk.

Following the assessment of conditions and the potential environmental risks associated with the project, mitigating design features can be defined. Some of the common approaches for mitigating the above potential effects are shown below:

Public Health

1. Control dust during construction activities and transportation of materials.
2. Proper handling of dispersed solid waste and litter during transportation and placement
3. Proper handling of the solid waste to prevent odor.
4. Controlling animals and insects which can cause disease transmission
5. Applying regular cover over the placed solid waste during operations.
6. Controlling waste pickers to prevent fires and litter.
7. Controlling and minimizing noise levels during the construction and operation activities.

Occupational Health and Safety

1. Control dust during construction activities and transportation of materials.
2. Implement safety procedures and provide personal protection equipment for workers.
3. Train drivers and workers on the proper handling of waste materials and the use of personal protective equipment.
4. Train employees to identify hazardous waste and use proper safety procedure on handling and reporting these materials if they are received.
5. Collect and manage domestic wastewater resulting from construction and operation activities in a safe manner.

Socio-Economic Conditions

The project can have positive impacts on local residents by increasing the economic impact on local residents and businesses in different sectors such as transportation, repair maintenance, etc.

Water Resources – Some of the ways by which water resource effects can be mitigated include the following:

1. Waste oil produced from equipment during the construction and operation phases should be collected and disposed of in an appropriate manner.
2. Wastewater generated from workers at the site during construction and operation should be handled and disposed in an environmentally sound manner.
3. Collecting and treating leachate: This may involve installing a liner that allows leachate to be collected and treated. Indigenous clay soils may be used for this purpose.
4. Leachate treatment should be designed so that it achieves its desired purpose in an effective manner. Leachate recycling to the landfill or for irrigation use should be identified and implemented if possible.
5. Groundwater and surface water should be monitored periodically by taking samples from monitoring wells or surface water courses.
6. All surface water flowing to and through a site should be diverted so that it does not come into contact with placed solid waste. Berms and ditches installed for this purpose should be regularly maintained to assure their function.

4. HO TO GET A COMMUNITY TO ACCEPT A NEW DISPOSAL SITE LOCATION

Basis - Community acceptance of a new disposal site is often a major problem. The public's perceptions of new disposal areas proposals is usually based on their experiences with current practices. Accordingly, if the current disposal location within any area consists solely of open dumps with significant environmental problems; people's attitudes are governed by the fact that this is what they expect in the future. Therefore, a significant effort is required to change people's attitudes about a new disposal area planned in their vicinity. The best way to achieve this is to make improvements in all other aspects of solid waste management so as to demonstrate a new focus on achieving improved service. If people see improvement in the collection process, for example, there are more likely to believe that a new disposal area can be designed and operated to an improved standard.

Desired Result – Increased knowledge on the ways to build community consensus for accepting a new disposal location

Analysis and Recommended Procedures – One of the most difficult problems in developing effective solid waste management is the siting of new disposal areas and transfer stations. What makes this issue so difficult is that it doesn't only include technical issues and concerns but also involves social, economic and political ones as well. Some of the common issues include the following:

1. **Environmental and health risks** - Facilities must be sited, designed and operated in a manner that prevents groundwater and surface water contamination as well as minimizing other effects such as potential traffic due to trucks delivering solid waste.
2. **Economic factors** - Solid waste management facilities can have an impact on property values and potential future land use. The cost to construct and operate facilities to mitigate its potential negative effects must also be factored.
3. **Social issues** - This can include social equity, the effect on a host community's image and anesthetics as well as the impact on informal waste pickers who may rely on disposal areas for their livelihood.

4. **Political issues** - This can include the impact of local elections, or the aggressive approach that community groups may take in opposing new proposed locations. Political issues may also include the manner in which local control is imposed on how the site will ultimately be operated. For example, government officials responsible for developing new disposal area must recognize the need to involve community leaders from the area where the new facility is located. This involvement should continue throughout the operational life of the disposal area.

With the above in mind, it's clear that attempting to find and develop new disposal sites can become a complex issue that goes well beyond just the technical aspects of which site has the best physical features. While proponents of a new disposal site should point out and believe that the new disposal area will be designed and operated in accordance with improved standards, the reality is that nearby residents will not necessarily believe them. As a result, there are many instances where new potential disposal locations with excellent physical characteristics have not been developed due to significant community or political opposition. As a result, the disposal area development process should include the preparation of a public participation plan.

Public Participation Plan - There are common approaches that are successful in gaining community consensus or support or, at a minimum, quiet acceptance of new disposal sites. People generally understand and support the need for effective solid waste management. However, their perception will usually be that their solid waste management needs can best be served in locations that are away from where they live or work. With the recognition that local opposition can hinder or even prevent siting of solid waste facilities, a public participation plan should be developed for implementation of any new major solid waste facilities including disposal areas and large scale transfer facilities. In large cities, experts are often hired to manage the public participation process. However, in smaller scale applications as would be expected in Aceh Besar and Aceh Jaya, a public participation process may be directly managed by the people responsible for implementing SWM program elements.

The public participation plan should outline the procedures that will be followed in engaging the public in the process. Basic to this plan is the need to engage the public early in the site selection process even before specific sites have been identified. This will help to improve the facility siting process and help gain public acceptance of the results. The plan should describe in detail the activities that will be conducted including their sequence and timing. The plan should also identify who is responsible for the public participation process. At a minimum, the plan should include:

1. **The objectives of the public consultation process** – The objectives would usually involve: 1) ensuring public understanding of the site selection process, 2) soliciting public concerns, 3) identifying and reviewing alternatives to mitigate those concerns, and 4) making decisions.
2. **An identification of the stakeholders that need to be addressed** - Key stakeholders can include, but not be limited to, residents living near a proposed site, representatives of waste pickers, environmental groups, concerned citizens, and public officials. In addition, the process may also invite the participation of waste management professionals, or other individuals with a vested interest in the process.
3. **Identification of the key issues that must be addressed** - The issues of concern are usually tied closely to the vested interests of each stakeholder group. Making sure that all their concerns are under discussion is important in building consensus on the need for and specific aspects of a particular site.

4. **An assessment of the appropriate participation techniques that will be required to accomplish the objectives** - The techniques employed must recognize that public involvement can usually take place at three levels including: 1) information distribution, 2) listening, and 3) collaboration in making decisions. The choices normally utilized in such programs are defined by a number of factors that include: 1) use of various media such as newspapers, radio, television, and the internet to distribute information, 2) the literacy and education level of the people for whom information is generated and distributed, 3) the objectives of the consultation process (inform, listen, or decision-making) and 4) local customs as to how collective decisions are made.
5. **A budget for the process** - Sufficient money must be available that recognizes how important is overall public participation process is. The budget must include the resources for use of media identified as the best means for engaging a public as well as for other things such as staff time, meeting expenses, photocopying and printing, and any other costs associated with the public participation process.

For developing new disposal locations, the public participation process will have two distinct phases. The first phase is utilized in a regional siting effort while the second phase is associated with local siting once a specific potential site has been identified. Regional siting is the process of developing a list of possible locations within a given region and then narrowing down the list to the most promising location or locations. The recent exercise in searching for a new disposal site for the City of Banda Aceh is a good example of a regional scope siting process.

Local siting is the process of determining whether a specific selected local site is technically viable and acceptable to the public. This latter process usually involves public consultation during scoping as well as in the completion of an environmental impact assessment. The advantages of engaging the public during the regional siting process is that it helps in providing more strength to the conclusions reached. This helps to build consensus that will be important once a specific site is located and local opposition may develop. The objectives of involving the public during the regional siting process are to:

1. Help the public understand the current and projected solid waste problems that the siting process is seeking to overcome. This needs to include both economic and environmental issues.
2. Engage the public in a process where there are mutually developed and accepted evaluation and site selection criteria that goes beyond simply the interests of the government solid waste managers involved in the SWM process.
3. Help develop early in the process alternative measures that will address the concerns that may be raised by the public during the local siting process once a specific site is announced.

There is usually much greater interest in siting when one or two specific sites have been announced. This is usually the phase of a project where public opposition develops. However, public participation throughout the entire siting process (regional and local) will help provide information that addresses the concerns raised at the time of local siting. The objectives of involving the public during the local siting process seek to:

1. Help the public understand the project and its possible impacts (both negative and positive),
2. Provide an opportunity for the public to suggest ways to mitigate project impacts,
3. Provide the public an opportunity to suggest possible impacts to be evaluated during the environmental assessment process that should follow the selection process.

The techniques used during public engagement during the local siting process are similar to those used during regional siting. However, they may also include a more focused efforts aimed at specific target groups from the locales where the proposed facility is located.

In organizing a public participation program, there are a few key issues that need to be specifically addressed. One of these is the manner in which risk is communicated. The public perception of risk will be based on their view of current SWM practices and the track record of public officials and agencies proposing the new site. General experience has shown that severe public opposition to new disposal sites are primarily due to problems of trust, information quality, or poor decision-making processes. To be successful, people managing the public participation process for a new disposal site must work diligently to mitigate public concerns including an attempt to 1) build trust in the people who will administer the resulting project, 2) provide good information that is not misleading that can stand the scrutiny of individuals who may have some background in solid waste management, and 3) developing a process that is transparent and objectively-based with appropriate public input mechanisms.

In discussing project risk, people proposing a new disposal area must be prepared to define for the public the accurate nature of the risks that are involved including the hazards, probability of public exposure to each hazard, total population at risk, etc. Along with this, the benefits of the project need to also be defined and presented so that a balance can be defined between risk and benefit. Good information has to be provided in a manner that will be understood by the public that may be affected.

Mitigating Negative Impacts - Negative impacts can arise as a result of landfill and transfer station siting. As a result, it's necessary to attempt to address each of the identified potential negative impacts and to mitigate their effects. Anticipating those effects based on experience can provide a good basis for information presented during the public engagement process. Mitigation involves the process where people's concerns are identified and a specific attempt is made to address them through design or development of operational procedures. This requires good and credible information aimed at the specific concern. Concern mitigation can involve specific activities such as road improvements or other infrastructure that might provide an additional benefit to the community in exchange for the increased risk that they perceive is associated with the new landfill site. However, disposal area developers need to be careful with the use of benefit compensation if the public perception of risk has not been addressed. If the public affected by a local site does not believe that the risk can be compensated for at any level, their opposition will continue irrespective of attempts that are made to mitigate their concerns. It is generally been found in disposal area siting that public groups will prefer prevention and control measures rather than compensation to mitigate risk.

The following are a list of the common concerns and mitigation measures that will, most likely, be raised by the public in developing a new disposal site.

Ground and Surface Water Quality

1. Provide adequate geological and hydrogeological studies to define actual physical conditions and pollution potential
2. Educate the public on modern landfill design and operation
3. Sponsor field trips for community leaders to good facilities that show that public concerns can be addressed

4. Explain the risks associated with disposal area design and operation
5. Explain laws and regulations that will help control perceived and actual risk
6. Establish a transparent monitoring program aimed at mitigating the risk and giving the public a chance to review the monitoring information as it is generated

Negative Community Image Due to the Disposal Area

1. Design and landscape the site with visual buffers such as trees and berms
2. Sponsor field trips to existing facilities that demonstrate good site design and operating standards
3. Finance a study to show what effects the facility will have on property values
4. Guarantee that routine litter cleanup will be done along main access roads and a wind fence will be used at the disposal area work face to control blowing litter.

Traffic Congestion and Safety

1. Increase the use of traffic attendants to ensure safe access at the site entrance
2. Limit the number of trips to and from the facility by considering transfer stations

Noise

1. Adjust disposal area operating hours to minimize noise after normal operating hours
2. Provide berms or other sound control structures
3. Identify alternate traffic routes to and from the facility

Odor

1. Minimize the size of the working face where waste is placed
2. Cover all waste the end of each workday or on a regular basis
3. Provide landfill gas ventilation possibly with flares for combustion of the recovered gas

Dust

1. Take steps to reduce dust through watering access roads or active work areas on days that it is required.

All Impacts

1. Set up a communication process by which complaints can be received and addressed
2. Establish a communication link between the community and a liaison person to regularly communicate about the function of the disposal area

5. HOW TO OPERATE AND MAINTAIN A DISPOSAL SITE

Basis - The development process for a new disposal site creates an expectation of how the facility will be operated and maintained. During the development of the site, an operations plan should be written that identifies all the procedures that will be utilized in operating and maintaining the facility. This operations plan should have sufficient detail that would allow any outside observer to understand what is required to operate at facilities into by reviewing the plan. In many countries, a regulatory process exist by which facilities such as transfer stations and disposal areas are monitored to assure that design and approval expectations are met. However, if the regulatory process is not in place to monitor the operation and maintenance of a disposal site, it doesn't necessarily mean that operators can do anything they want. Solid waste managers responsible for disposal areas must keep in mind that their operation and maintenance will be the basis by which future planning and expansion or replacement of facilities is viewed.

Desired Result – Increased knowledge on issues associated with the proper operation and maintenance of disposal sites.

Analysis and Recommended Procedures – The following are some of the important means for achieving the desired result.

1. A disposal or operations plan should be developed prior to commencement of operations. This plan should provide and define all procedures to be used in operating and maintaining the disposal area. This should also include the manner in which equipment will be utilized and maintained in the operation of the facility. The content of the Banda Aceh Gambong Jawa landfill Operations Manual prepared by the Asian Development Bank is shown at the end of this Annex section.
2. Use of heavy equipment such as compactors or bulldozers increases the capacity of the landfill by achieving greater compaction and allowing a cell configuration to be developed.
3. Daily soil cover (about 15 cm) helps in reducing odors, vectors, and fires. Soil quality for cover is not overly important except for not using cover materials that are impervious so that leachate close to the surface on top of the impervious cover.
4. Periodic topographical survey of the disposal area helps in determining how much of its design capacity is being utilized. Such data is valuable in planning for system expansions or replacements.
5. Planting native shrubs and trees along the boundary of the landfill makes it less visible to neighbors. These buffer materials need to be maintained so that they remain effective.
6. A daily log of the disposal area activities should be maintained by the site manager. This record of activities provides good information for management including a greater ability to deal with complaints that may be received concerning the facility.
7. To the degree possible, a record should be kept of the amount of solid waste received at the facility. If a weighbridges not available, these records could include the logging in of delivery vehicles along with their time of arrival and leaving the site, brought in by the vehicle. Such records can be important in reviewing the effectiveness of a collection system and managing the productivity of collection crews.
8. Monthly summary reports on trucks, waste received, number of people employed, field problems, rainfall, leachate generation, money spent on fuel, salaries and other expenses. Such information is important in monitoring the function of a disposal area and in determining budgets or user fees for effective operations.

6. HOW TO CONTROL WASTE PICKERS

Basis – Informal recycling occurs in a number of SWM processes. Waste pickers work at disposal areas to recover materials that may have value. Additionally, materials are separated during collection. This can include separation of material by waste pickers at TPS or by waste collectors themselves who separate out materials of value as they perform their collection duties. While these practices do divert material from final disposal, they often do so at the expense of safety or collection efficiency.

Currently, brokers exist in Banda Aceh who will pay for recovered materials such as some forms of plastics and metal beverage containers. A number of brokers are located on the approach road to the Gampong Jawa disposal area. These brokers will pay for recovered materials as determined by portable scales. (Current rates for metal containers is about 5,000 Rupiah per kilogram.) The brokers accumulate and bag recovered materials that they buy and eventually transport the material to manufacturing plants in Medan.

Unless controls are put into place to prevent informal waste picking at disposal, it will continue. There are relatively strong commercial connections exist between waste pickers, intermediate brokers and the manufacturers of products derived from the recycled materials. The entities tend to operate in a commercially dependent relationship, with the "informal" waste pickers serving as suppliers to the "formal" broker or manufacturer.

Informal activities such as waste picking, unlike the formal sector in waste collecting and recycling, are often driven by poverty. The choice of materials to collect is generally determined by the value of the recovered materials which is directly determined by available markets.) In addition to market conditions, materials to recover are often selected by their ease of extraction, handling, and transport. Paper, metals and plastics tend to attract more attention than organic or biodegradable materials both from a market and ease of handling perspective.

Experience has shown the following concerning waste pickers.

1. Waste pickers are often among the poorest segment of the population. They usually have few assets and few alternative livelihood options if their earnings from waste picking are threatened.
2. The majority of waste pickers are independent and self-employed, so they have no organizational support to help them through difficult times.
3. Waste pickers may be of any age and gender and include children who are trying to help supplement family income.
4. Many older people are involved in waste picking. In many countries, more women undertake this function than men. Often they are single mothers, who bring their children to disposal areas while they work.
5. Changes in collection and disposal practices can ultimately affect waste pickers and their livelihoods
6. Programs can be developed for improving the income, working and living condition for waste pickers. Doing this, however, requires an understanding of the situation of waste pickers, their motivations for doing this work, their occupational and living conditions, and the organizational framework within which they work and live.
7. Many of the people injured or killed during disposal area slope failures such as those that have occurred in Indonesia and the Philippines were families involved in waste picking and living around the disposal areas where they worked.

Desired Result – Increased knowledge about the ways to manage waste pickers at the disposal area or in the collection system.

Recommended Procedures - The following are some of the important means for achieving the desired result.

1. In many countries, waste pickers earn their livelihood by picking out materials from solid waste streams that may have value. Waste pickers may operate at disposal sites as well as throughout the collection system. If waste picking is not prohibited, the role of the informal sector waste pickers should be recognized and, to the degree possible, controlled so as to prevent problems associated with the waste picking process.
2. In the collection system, waste pickers should be closely monitored to assure that they do not create litter as they seek materials to recover at TPS or container locations.
3. If waste pickers are not prohibited from disposal areas, workers at these areas should closely control traffic so as to prevent accidents involving waste pickers.

4. At some disposal areas, waste pickers are required to use basic personal protective equipment such as boots and gloves. Such a requirement can be important in reducing the dangers associated with the close contact that waste pickers normally have with the various types of solid waste brought to a disposal area.
5. At disposal areas, waste pickers should be controlled so as to prevent unsafe conditions. This is especially the case at disposal sites where there is a high concentration of delivery or operational vehicles. Workface spotters need to be extremely careful in making sure that waste pickers, particularly children, are not hurt by truck or equipment movement.
6. Reasonable standards of performance should be developed at disposal sites for waste pickers and these should be enforced for health and safety reasons. The standards of performance should also be designed so as to maintain the efficiency of the disposal area operations.
7. To the degree possible, information should be provided to waste pickers explaining the dangers of certain materials that may appear at disposal areas.
8. In some disposal areas, areas are set aside where waste is deposited to be accessible for waste pickers. This then requires that remaining waste after waste picking be relocated to the disposal area workface.

EXAMPLE CONTENT OF DISPOSAL AREA OPERATIONS MANUAL

(Source: ADB Operations Manual For Gampong Jawa Landfill in Banda Aceh

1. Executive summary
2. Policy statement and license agreement
   - 2.1. Customer advice
   - 2.2. District/municipal commitment
   - 2.3. Permits and approvals
3. Staffing and facilities
   - 3.1. General staffing and responsibilities
   - 3.2. Training
   - 3.3. On-site facilities
   - 3.4. Signage
   - 3.5. Security fencing and Gates
4. Safety
5. Reporting procedures
   - 5.1. Daily diary and report sheets
   - 5.2. Complaints register
   - 5.3. Operating license reporting
6. Waste categories
   - 6.1. Summary of categories
   - 6.2. Acceptable waste (General)
   - 6.3. Difficult wastes (but acceptable)
   - 6.4. special wastes (sometimes accepted)
   - 6.5. Prohibited wastes
7. Difficult wastes
   - 7.1. Tires
   - 7.2. Mattresses
   - 7.3. White goods
   - 7.4. Car bodies
   - 7.5. Drums
8. Special wastes
   - 8.1. Asbestos
   - 8.2. Dead animals or obnoxious waste
   - 8.3. Non-toxic liquid waste
   - 8.4. Toxic liquid waste
   - 8.5. Oily waste water
   - 8.6. Acid/alkali/metal wastes
   - 8.7. Paint/pesticide/solvent waste
   - 8.8. Pathogenic and medical waste
   - 8.9. Contaminated soil
   - 8.10. Biological sludge
   - 8.11. Batteries
9. Incoming load inspection procedure
   - 9.1. Background
   - 9.2. Managing prohibited substances
10. Site preparation
    - 10.1. Purpose
    - 10.2. Survey
    - 10.3. Installation of clay liner
    - 10.4. Construction
    - 10.5. Leachate collection
    - 10.6. Access roads
11. Cell construction
    - 11.1. Construction of operating cells
    - 11.2. Impact on recycling issues
12. Operation of a cell
    - 12.1. Description a cell operation
    - 12.2. Spreading waste
    - 12.3. Daily cover
    - 12.4. Sequence of filling
13. Effective use of equipment Rainwater runoff management
14. Leachate management
    - 14.1. Description
    - 14.2. Leachate control
    - 14.3. Leachate system
    - 14.4. Leachate monitoring
    - 14.5. Emergency action
15. Litter control
    - 15.1. Tipping area
    - 15.2. Boundary fence
    - 15.3. General site
    - 15.4. Access roads
    - 15.5. Responsibility
16. Pest control
17. Fire control
    - 17.1. Notification procedure
    - 17.2. Firefighting procedure
18. Dust control
19. Emergency phone numbers
20. Glossary of terms

Appendix A – Standard Forms

ANNEX 6 - MEDAN USAID/ESP SOLID WASTE INITIATIVES INSPECTION REPORT

1. COMMUNITY – BASED SOLID WASTE MANAGEMENT INITIATIVES ALONG THE PERCUT RIVER IN DESI SENLANG – INSPECTION REPORT

A. BACKGROUND

On Thursday, 3/29/2006, I met with Julian Syah and Ricky Barus of the USAID sponsored Environmental Services Project (USAID/ESP) in Medan, Indonesia. Among other things, USAID/ESP has been working on a number of solid waste management (SWM) initiatives focused on the community level programs in Desa Tembung and Kelurahan Kenangan in Kabupaten Deli Senlang. These focus locations were selected in cooperation project team from the Medan Flood Control Project sponsored by the Japanese government (MFCP/JBIC).

USAID/ESP activities within the focus communities have included education and consensus building programs including solid waste management. Program elements have also included "train the trainer" approaches to expand program coverage and replicabiulity. Numerous meetings have been held with the community to educate them concerning the proper management of solid waste. This work has been ongoing in parallel with development of the MFCP/JBIC flood control project. In addition to its flood control objectives, the MFCP/JBIC project includes secondary infrastructure intended to provide a means for collecting solid waste in a number of communities along the Percut River including the USAID/EST target communities. The intent of MFCP/JBIC solid waste management infrastructure is to prevent the dumping of solid waste into the river which could have a long terms effect on the flood control intent of their project. Currently, the common practice for communities along the river is to simply bring their solid waste to the bank of the river and randomly dump it. Unfortunately, this is a common practice throughout Indonesia because of the general unavailability of a formal solid waste management program.

Numerous meetings were held by the USAID/ESP field team with community leaders and members who have been spearheading the solid waste management development up with the community. During my inspection of the project site, we were accompanied by a number of the community volunteers who have been involved in the evolution of the community SWM program. Based on the dialogue and interest expressed at during the inspection visit, it appears evident to the author that the community engagement process has worked well and that the community is prepared to adopt the new solid waste management program once all infrastructure is in place and other integrated processes are ready to begin operation.

Observations concerning the subject community and its existing or proposed solid waste management practices made during my inspection include the following:

1. There is limited or no vehicular access to significant portions of the community. This limits the choices by which solid waste could be collected on a door-to-door basis.
2. Past practices and generally involved solid waste generators bring in their solid waste to the riverbank and dumping it along the bank and into the river. Dumping areas along the river are shown in the photograph to the left.
3. Waste pickers were observed working along the riverbank recovering materials that they could sell to nearby brokers.
4. Currently, existing structures have been installed along the riverbank adjoining the Percut River and the Tambung XI community area. While these structures are built with the same general characteristics as many of the TPS structures typically utilized as primary collection points in Indonesia, Weng Shih Chou of CTI Engineering Co. Inc., the representative of the MFCP/JBIC project, indicated that the contractor for the flood control project had install these as a temporary measure aimed at providing a means for burning of solid waste placed in them in lieu of river bank dumping. However, it appears that community members have viewed these as intended collection points where solid waste to be picked up and transferred out of the area. Currently, solid waste has accumulated at the structure locations and has not been picked up. The accumulated material results from deposits made since the units were first installed late in 2005.

Medan Riverside Solid Waste Dumping Locations

It is my understanding that community leaders and focus group members have been questioning the USAID/ESP field team as to the schedule for implementation of the full SWM program described to them during the community capacity building and consensus meetings. At present, this schedule is totally on the availability of secondary collection infrastructure associate with the project that is the responsibility of the MFCP/JBIC project.

The MFCP/JBIC project will provide all physical infrastructure required for the solid waste management component of their project. This will include, the physical construction of collection stations and transfer depots, the provision of mechanized equipment required for secondary collection, and the provision containers for receipt of solid waste that transfer depots as well as multipurpose community centers that can provide some administrative support for the community level solid waste management programs in the communities within the project service area.

B. SWM PROGRAM DESIGN

The design intent of the system is to provide solid waste collection in various communities along the Percut River including the USAID/EST target communities. The SWM program will consist of two basis elements including a primary collection program which will be the responsibility of each community and a secondary collection and transfer program that will receive waste from the primary collection program. The communities will be responsible for cart-based collection or transfer to the collection depots where solid waste will be placed in arm-roll containers for eventual transport to the disposal area. Each collection depot is designed with space for two containers. The MFCP/JBIC is currently communicating and negotiating with the Dinas Kebersihan for their assumption of responsibility for secondary collection and transfer of the containers to the TPA in exchange for all of the physical infrastructure that the MFCP/JBIC project will provide.

During a meeting with Mr. Weng Shih Chou at the MFCP/JBIC offices in Medan, the design for solid waste management infrastructure components was reviewed. Detailed design of the MFCP/JBIC solid waste management infrastructure components has been completed. This included design for collection stations, containers, transfer depots, and community centers. Each of the components is of a conventional design and appropriate for the proposed application. The components proposed by MFCP/JBIC include:

1. **Collection carts** – these are intended to allow solid waste collection from the community areas and transport of the solid waste to the collection stations or transfer depots.

Typical Fixed TPS Structure

2. **Collection stations** - Fixed collection stations similar to that shown on the photograph below are proposed along both riverbanks throughout the MFCP/JBIC project area which extends well beyond the village areas within the USAID/EST focus communities.
3. **Transfer depots** - Transfer depots have been strategically located within the MFCP/JBIC project area. These are designed to allow placement of two arm-roll containers. These transfer depots will be the dividing responsibility line between the primary collection program which is the responsibility of the community and the secondary collection and transfer program which will, hopefully, become the responsibility of the Dinas Kebersihan for the region. The container configuration of

the transfer depots will provide scheduling and management flexibility in the secondary collection/transfer program while maintaining sufficient capacity for continuous and reliable service to the community's primary collection program.

4. **Arm-roll containers** proposed for the MFCP/JBIC project are similar to those shown in the photograph.
5. **Community centers** – In their project design, MFCP/JBIC is also proposing to construct the community centers that will, among other things, provide sufficient space for meetings and or training associated with the primary collection program or other solid waste management elements.

C. RECOMMENDATIONS

Based my observations and meetings, I would recommend the following concerning the project:

1. There needs to be close coordination between the USAID/ESP staff and the MFCP/JBIC staff. During a meeting with Mr. Weng Shih Chou, the design intent of the MFCP/JBIC solid waste management subcomponent was described. This design intent appeared to be different than the understanding that the USA ID ESP staff had concerning the intent and design of specific components such as the temporary structures that have already been constructed along the riverbank. This close coordination should include regular discussion concerning the progress and pace of the MFCP/JBIC project particularly in terms of their construction schedule for SWM components and their negotiations with the Dinas Kebersihan relative to the assumption of responsibility for the secondary collection and transfer elements of the project.
2. The USAID/ESP project team should attempt to get copies of the MFCP/JBIC solid waste management infrastructure design plans. This will allow more focused discussion with the community concerning tentative location of collection points, design of infrastructure, etc. In addition it will allow for more detailed planning of the primary collection program that will be the responsibility of the community. This detailed design should then establish the anticipated cost of the primary collection function so that can be planned for. Cost coverage of all elements will be required for total program sustainability.
3. USAID/ESP staff should verify through discussion with MFCP/JBIC representatives that hand carts will be provided to the communities for the primary collection program
4. At our meeting with MFCP/JBIC, a suggestion was made by Julian Syah to Mr. Weng Shih Chou that a workshop be held (with his participation) with USAID/ESP focus community leaders members to outline the intent of the MFCP/JBIC project and to provide a further description of its components. I strongly concur with the need to create this information distribution as to the progress being made in developing the solid waste management infrastructure and to reinforce the MFCP/JBIC intent in the project.
5. According to Mr. Weng Shih Chou, the temporary structures that have already been constructed along the riverbank are intended to provide a location where solid waste could be incinerated on an interim basis in lieu of river deposit. Although these structures (as shown to the right) were not intended to be permanent transfer structures to a secondary collection program, I would strongly urge against advising the community to consider burning solid waste at these locations. This would only serve the purpose of creating an air pollution issue in lieu of dumping solid waste into the river. If a workable and reliable schedule is maintained on the

development of the MFCP/JBIC, the community should be advised of that schedule and progressed tracked so that their enthusiasm for the intent of our capacity building and education does not wane.

6. The project needs to have a continued focus on the integrated nature of all of SWM infrastructure components and processes. For example, integrated solid waste management involves all of the participants in the SWM scheme. In this project, this will include the community as solid waste generators and managers of the primary collection system and Dinas Kabersihan who will, hopefully, manage the collection depots and transfer solid waste to the disposal area. Based on my limited observations, it appears that the intent of the community work by USAID/ESP has been achieved and the community is prepared to do its part. However, the benefits of that community consensus and capacity building will not be realized if the MFCP/JBIC infrastructure is not put into place. The USAID/ESP field teams should endeavor to make the community understand that the schedule for the remaining infrastructure work is totally in the hands of the MFCP/JBIC project.

Tambung XI Community (Medan) Interim Disposal

7. In light of the above point, a contingency plan should be prepared to attempt to salvage some aspects of the community building work that has been accomplished by USAID/ESP through beginning work as soon as possible on other parallel initiatives aimed at solid waste diversion (recycling, composting, etc.)
8. The advantage that the MFCP/JBIC may have in dealing with Dinas Kebersihan is that all the equipment for the secondary collection transfer program will be provided by the flood control project. This equipment may provide some flexibility to Dinas Kebersihan in its other solid waste management responsibilities. This should provide sufficient incentive for Dinas Kebersihan's interest in the adoption of the responsibility for managing the secondary collection components of the overall MFCP/JBIC program. To the degree that USAID/ESP can assist in convincing Dinas Kebersihan as to the merits of their involvement, it should do so.
9. As previously recommended, regular meeting should be held between the MFCP/JBIC project team and USAID/ESP to the track the pace of completion for solid waste management of the structure components. To the degree possible, the community primary collection program should be developed in a manner and schedule that allows for both the primary collection and secondary collection/transfer processes to come on line at the same time. For example, primary collection will not work is the secondary program is not activated to receive the collected waste.

10. The Japanese representative indicated that they are also attempting capacity/ consensus building and community relation work in a number of priority communities. This work has included instruction on waste diversion through recycling and/or composting. The design intent of this emphasis is to reduce the amount of solid waste that will eventually be managed by the primary and secondary collection programs resulting from the flood management project SWM component. A similar emphasis should be adopted in the USAID/ESP target communities through training and potential pilot work associated with small-scale compost projects or source separation of recyclables. Source-separated recyclables might be a way to provide additional compensation for cart operators within the primary collection system. This, in combination with direct payments by generators, may help to provide sufficient financial stability to cart operators and efficiency to the overall primary collection program by enhancing the pay derived by the people who will physically undertake the primary collection process. To the degree possible, the existing small scale recycling that is occurring along the riverbank near the target community should be evaluated and integrated into the design of the community supported program.
11. To the degree possible, USAID/ESP should assist MFCP/JBIC in their community relation work. This will enhance USAID/ESP knowledge of the progress being made in the overall project.

2. RECYCLING INITIATIVE – MEDAN MARELAN DISTRICT IN THE CITY OF MEDAN, INDONESIA- INSPECTION REPORT

A. BACKGROUND

On Thursday, 3/29/2006, I met with Julian Syah and Ricky Barus of the USAID sponsored Environmental Services Project (USAID/ESP) in Medan, Indonesia. Among other things, USAID/ESP has been working on a number of solid waste management (SWM) initiatives focused on the community level programs in the Medan Region. One of the program initiatives reviewed was support given to a micro-enterprise plastics recycling operation in Terjun Village in the Medan Marelan district of the City of Medan.

Medan Marelan is the district in which one of the principal disposal areas (TPA) for the City of Medan is located. The above reference project, however, is not located at the disposal area as are other similar informal recovery operations but located in the community from which material is collected directly from community generators.

In its community support initiatives, the USAID/ESP project office in Medan has been providing technical assistance to the small scale community-level plastics recycling operation being operated as a micro-enterprise by one of the residents of Terjun Village. In a meeting with the owner of the enterprise, Mr. Sahdan, I was advised that he has been in operation for eight months and that, at this point, he employs a number of people from the village. Waste generators in the village bring their plastic material to his workplace which is located at the rear of his residence. Mr. Sahdan has also been able to develop a recycling relationship with one or two businesses that also bring him their separated materials. Mr. Sahdan pays a token amount for the material received thereby giving waste generators in the village an incentive to separate the plastic material and bring it to his location. Mr. Sahdan then cleans and consolidates the material and, once sufficient material is accumulated, it is picked up by a local broker who pays him for the material. The USAID/ESP field team is working to provide

Mr. Sahdan assistance in developing and expanding his business while also seeking to replicate the approach in other locations.

B. RECOMMENDATIONS

Based my observations and the meeting with Mr. Sahdan, I would recommend the following concerning the Medan Marelan recycling initiative:

1. USAID/ESP should continue their technical support of Mr. Sahdan in optimizing and expanding his business. This should include providing the means for exposing him to other such projects and technical approaches in the region that have been successful
2. At the point when Mr. Sahdan has been in business for one year, USAID/ESP staff should develop a case study analysis of his operation identifying its basic technical and economic structure including business strengths, weaknesses and vulnerabilities. This will be useful in replicating the experience (with modifications, if required) in other communities that USAID/ESP is working in throughout Indonesia. The case study analysis should then be used in workshop settings to emphasize waste diversion and livelihood aspects of the example. A good candidate for such a workshop would be a general workshop organized for community leaders from the service area of the Medan Flood Control Project sponsored by the Japanese government (MFCP/JBIC). This would include USAID/ESP focus communities as well as other communities that will benefit from the solid waste management infrastructure elements to be provided by MFCP/JBIC as part of their flood control project. This workshop could focus on the solid waste collection process inherent to the MFCP/JBIC project as well as waste diversion opportunities such as those represented by Mr. Sahdan's business.
3. USAID/ESP should undertake an analysis of the informal recycling business structure in the area. This analysis will provide important information for replicating the above recycling program and development of other programs involving different materials. This analysis should include a number of elements including:
    a. Identification and location of recovered material brokers in the area
    b. Type of material collected
    c. Manner in which the recovered material is transported to the brokers from collectors and small operations like Mr. Sahdan
    d. Specifications (quantity, condition, etc.) for material accepted by the broker
    e. Final destinations for recovered materials
    f. Amounts paid to people like Mr. Sahdan for recovered materials
4. With the above information, USAID/EST should consider developing a short business model for small scale community or micro-enterprise recycling operations that will serve as a template for developing other waste diversion processes in USAID/ESP focus communities.
5. Using the livelihood aspects of Mr. Sahdan's operation, USAID/ESP should evaluate the feasibility of developing other similar operations in Terjun village for other recovery of other materials or for other waste diversion processes (organic material composting, etc.) This could also include the expansion of Mr. Sahdan's business into the recovery of other waste components depending on the market conditions evaluated in Item #3 above.

In addition to any direct support that USAID/ESP is able to provide, USAID/ESP field team members should periodically visit Mr. Sahdan's work site to monitor his operation and progress and to demonstrate continued interest in his effort and success.

ANNEX 7 – MENGEMBANGKAN LAYANAN PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

MENGEMBANGKAN LAYANAN PENGUMPULAN LIMBAH PADAT YANG EFEKTIF




Panduan Untuk Pengumpulan Limbah Padat Di Kota Manado, Sulawesi Utara

January 2004

Research Triangle Institute (USA)
In association with
PT Deserco Development Services

LAG-I-818-99-00009-00
Task Order 818, SUM IQC

DAFTAR ISI

DAFTAR GAMBAR

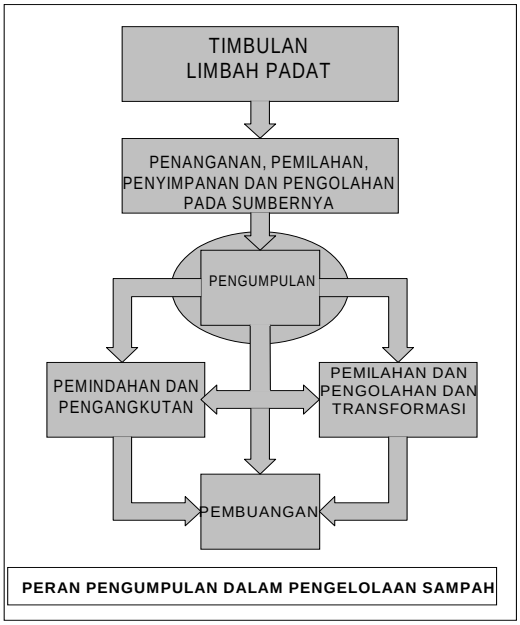
DAFTAR TABEL

MENGEMBANGKAN LAYANAN PENGUMPULAN LIMBAH PADAT YANG EFEKTIF DI MANADO

1. PETUNJUK PENGGUNAAN

Buku panduan ini dimaksudkan untuk memberikan pengetahuan dasar tentang pengumpulan limbah padat yang efektif dan berkesinambungan. Sebagai pendekatan yang diterapkan di sini, buku panduan ini menyajikan latar belakang kegiatan-kegiatan utama yang terkait dengan upaya untuk mencapai pengumpulan limbah padat primer yang efektif (di Manado berada di bawah kewenangan kelurahan dan lingkungan) dan pemindahan sekunder (berada di bawah kewenangan Badan Pengelola Kebersihan atau kecamatan). Untuk tujuan tersebut, informasi ini dimaksudkan untuk membantu pihak yang bertanggung jawab atas pengumpulan dan pemindahan limbah padat pada tingkat pemerintahan tersebut untuk:

1. **Menilai** pelaksanaan pengumpulan limbah padat yang ada saat ini;
2. **Merancang** sistem pengumpulan limbah padat primer dan sistem pemindahan limbah padat sekunder; dan
3. **Mengoperasikan dan memelihara** sistem pengumpulan limbah padat primer dan sistem pemindahan limbah padat sekunder untuk mempertahankan efektivitasnya setelah semua sumber daya tersedia dan tanggung jawab yang ditetapkan telah diemban.



Gambar 1 – Peran Pengumpulan dalam Pengelolaan Sampah

Pengumpulan dan pemindahan limbah padat merupakan fungsi yang sangat penting dan bagian yang tidak terpisahkan dari setiap program pengelolaan limbah padat secara terpadu. Hal tersebut menjadi penting karena pengumpulan dan pemindahan limbah padat merupakan

salah satu dari layanan publik yang paling mudah terlihat dan kelalaian dalam menyediakan layanan tersebut akan tercermin dalam kondisi yang dapat dilihat setiap orang di jalan-jalan dan saluran drainase di seluruh penjuru kota. Peran pengumpulan dan pemindahan limbah padat dalam program pengelolaan limbah padat secara terpadu (ISWM-*Integrated Solid Waste Management*) diilustrasikan dalam Gambar 1.1 di samping.

Semua unsur dalam ISWM merupakan hal yang penting dan permasalahan pada salah satu komponen dapat mempengaruhi keberhasilah dari komponen lainnya. Selain itu, tanggung jawab atas setiap fungsi mungkin melibatkan berbagai *stakeholder* termasuk penghasil limbah padat dan berbagai lapisan pemerintah di Manado. Karena itulah, diperlukan adanya suatu interaksi yang baik antara semua pihak jika ingin keseluruhan program pengelolaan limbah padat berhasil. Panduan ini dimaksudkan untuk memberikan bekal bagi pihak-pihak terkait dalam pengelolaan limbah padat pada semua tingkatan pemerintahan di Manado dan untuk membantu mereka dalam memahami tanggung jawabnya dan cara bagaimana mereka dapat memberikan layanan secara efisien dan berkesinambungan.

2. MENILAI PELAKSANAAN DAN KONDISI PENGUMPULAN LIMBAH PADAT YANG ADA SAAT INI

Titik awal setiap program untuk mencapai pengumpulan limbah padat yang efektif adalah penilaian atas pelaksanaan dan kondisi pengumpulan limbah padat yang ada saat ini. Hal yang sangat penting adalah bahwa baik perangkat keras (bak sampah, kendaraan, titik pemindahan, stasiun pemindahan, dll.) maupun perangkat lunak (penjadwalan, rute, sistem pembayaran, kerangka hukum/ politik, dll.) dievaluasi dan ditinjau dari berbagai sudut pandang (secara geografis, politik, kelembagaan, dll.) untuk menentukan bahwa aspek-aspek tersebut di atas sesuai dengan kondisi di mana pengumpulan dan pemindahan limbah padat akan dilakukan.

2.1. MENENTUKAN TUJUAN DAN HAMBATAN MASYARAKAT

Ketidak-mampuan untuk mengelola limbah padat kota dalam setiap masyarakat mungkin diakibatkan oleh permasalahan dan kegagalan dalam berbagai bidang, antara lain:

1. Layanan dan tingkat cakupan yang kurang memadai,
2. Pendanaan atau sumber daya keuangan yang kurang memadai,
3. Tempat pembuangan sampah yang tidak terkendali dan tidak memenuhi standar,
4. Kendali lingkungan yang tidak memadai pada setiap bagian dari program pengelolaan limbah padat,
5. Struktur kelembagaan yang belum optimal termasuk perundang-undangan yang tidak ekfektif yang tidak mengharuskan diterapkannya praktik-praktik yang baik,
6. Praktik-praktik sanitasi yang kurang memadai yang dilakukan oleh para penghasil limbah padat.

Pada dasarnya, pihak-pihak yang bertangung jawab atas pengelolaan limbah padat harus mengupayakan untuk menangani masalah-maslah tersebut di atas dengan menentukan tujuan dan standar bagi masyarakat yang dimaksudkan untuk menyelesaikan masalah-masalah tersebut. Tujuan-tujuan tersebut harus diupayakan untuk mengatasi masalah-masalah berikut ini:

1. **Perubahan-Perubahan Mendasar dalam Struktur Pengumpulan Limbah padat yang Diperlukan –** Dampak apa yang akan ditimbulkan oleh pembangunan sarana pembuangan sampah baru terhadap praktik-praktik pengumpulan sampah dan kebutuhan akan pemindahan sampah sekunder?
2. **Tingkat Layanan:** Tingkat layanan bagaimana yang diperlukan untuk memenuhi kebutuhan masyarakat? Harapan apa yang berkaitan dengan frekuensi pengambilan sampah dan peletakan tempat pengumpulan sampah bersama bagi para penghasil sampah?
3. **Peran sektor publik dan sektor swasta:** Apakah terdapat preferensi kebijakan berkaitan dengan peran sektor publik dan sektor swasta dalam penyediaan layanan pengumpulan limbah padat? Bagaimana sektor swasta informal akan ikut serta dalam program tersebut? Apakah sektor swasta informal cenderung menjadi hambatan untuk mencapai pengumpulan limbah padat yang efektif atau apakah mereka dapat menjadi aset dalam memperbaiki keadaan?
4. **Pendanaan Sistem:** Bagaimana setiap perbaikan dalam pengumpulan limbah padat dapat memperoleh pendanaan? Bagaimana untuk menjaga tingkat layanan yang efektif tersebut dapat memperoleh pendanaan secara berkelanjutan?

Setiap masalah tersebut di atas dipengaruhi oleh sejumlah faktor yang sering menghambat pengembangan dan pelaksanaan sistem pengelolaan limbah padat yang efektif. Faktor-Faktor tersebut antara lain adalah sebagai berikut:

1. **Hambatan Teknis** – Apakah terdapat keahlian teknis yang memadai untuk merancang sistem pengumpulan limbah padat yang efektif?
2. **Hambatan Keuangan dan Ekonomi** – Apakah tersedia dana yang memadai untuk membiayai perbaikan dan sistem yang diperlukan?
3. **Hambatan Kelembagaan** – Apakah peraturan di daerah cukup kuat untuk mendorong pengumpulan limbah padat dan praktik-praktik pemindahan limbah padat yang efektif? Apakah peraturan yang ada telah ditegakkan?

Pihak-pihak yang bertanggung jawab atas pengumpulan dan pemindahan limbah padat harus memahami sifat dan aspek-aspek lokal dari hambatan-hambatan tersebut sehingga menetapkan tujuan-tujuan yang wajar untuk pengumpulan limbah padat yang dapat dicapai dan dilakukan secara berkesinambungan.

2.2. MENETAPKAN TUJUAN YANG BERKESINAMBUNGAN UNTUK PENGUMPULAN DAN PEMINDAHAN LIMBAH PADAT YANG EFEKTIF

Pengembangan sistem pengumpulan limbah padat yang efektif memerlukan ditetapkannya tingkat layanan yang diinginkan. Frekuensi pengumpulan rutin dan jenis layanan pengumpulan yang disediakan kepada para penghasil limbah padat akan menentukan **Tingkat Layanan**. Jenis layanan akan mempengaruhi tingkat layanan yang diberikan dan pada akhirnya biaya pengumpulan limbah padat tersebut. Apakah tenaga pengumpul sampah mengambil sampah di lokasi tertentu seperti di pinggir jalan atau pekarangan belakang akan menentukan waktu yang diperlukan untuk setiap perhentian pengumpulan sampah dan pada akhirnya biaya yang berkaitan dengan perhentian tersebut. Pengumpulan sampah di pinggir jalan mewajibkan penduduk untuk meletakkan bak sampah (biasanya bak sampah standar seperti kantung atau tong plastik) di pinggir jalan pada hari pengumpulan yang telah ditetapkan. Hal ini biasanya

Gambar 2 – Kontainer yang Tidak Dilayani dengan Baik

lebih murah dibandingkan dengan layanan pengumpulan sampah di pekarangan belakang akan tetapi jauh lebih mahal dibandingkan dengan konfigurasi pengumpulan sampah bersama di mana para penghasil sampah diwajibkan untuk membawa sampah mereka ke titik-titik pengumpulan bersama yang telah ditetapkan. Penggunaan pengumpulan sampah secara terpusat melalui penempatan bak sampah di tempat-tempat strategis atau sarana pembuangan sementara dapat mengurangi biaya pengumpulan sampah dengan memfokuskan pengumpulan sampah di tempat-tempat umum yang melayani banyak penduduk penghasil sampah.

2.3. MENENTUKAN PRAKTIK-PRAKTIK YANG BERKESINAMBUNGAN UNTUK PENGUMPULAN LIMBAH PADAT

Salah satu masalah perkotaan yang paling sulit di setiap negara adalah pengelolaan limbah padat. Kekurangan-Kekurangan dalam pengelolaan limbah padat sering terungkap di desa-desa, kota-kota kecil dan kota-kota besar di negara-negara yang sedang berkembang di mana daerah miskin dan daerah terpencil sering menerima layanan yang minim atau tidak sama sekali. Di daerah-daerah lainnya, tingkat layanan sering tidak sesuai dengan atau tidak memenuhi standar yang diinginkan. Karena hal ini merupakan salah satu dari layanan yang paling mudah terlihat yang diberikan dalam setiap masyarakat, maka kegagalan progam pengumpulan limbah padat sering merupakan alasan mengapa orang-orang merasa bahwa program pengelolaan limbah padat tidak efektif. Walaupun hanya sedikit orang yang berhubungan secara langsung dengan tempat pembuangan limbah padat yang mungkin menghadapi masalah besar berkaitan dengan lingkungan hidup, setiap orang akan bersinggungan dengan sistem pengumpulan limbah padat dalam bentuk tertentu.

Tujuan utama dari pengumpulan limbah padat adalah semata-mata untuk memisahkan limbah padat secara fisik dari para penghasilnya serta sarana pengolahan atau tempat pembuangannya, yaitu tempat ke mana limbah padat tersebut pada akhirnya akan diangkut. Sayangnya, pengumpulan limbah padat merupakan salah satu komponen yang paling sulit dan rumit dari program pengelolaan limbah padat yang komprehensif. Dilihat dari sudut pandang ekonomi, pengumpulan limbah padat biasanya merupakan unsur dari program pengelolaan limbah padat yang memerlukan biaya paling banyak. Di negara-negara maju, pengumpulan limbah padat menelan hampir 60 sampai 70 persen dari keseluruhan biaya pengelolaan limbah padat, sementara pengumpulan limbah padat di negara-negara berkembang menghabiskan 70

sampai 90 persen dari keseluruhan biaya. Secara keseluruhan, pengumpulan limbah padat dan penyapuan jalan sering merupakan kategori pengeluaran terbesar dalam banyak anggaran belanja kota. Akan tetapi, besarnya pengeluaran tersebut dapat dibenarkan karena tidak berfungsinya atau tidak memadainya sistem pengumpulan limbah padat dapat menimbulkan dampak besar bagi kesehatan masyarakat dan dapat mempengaruhi mutu kehidupan dimana orang-orang tersebut tinggal dan bekerja.
Di banyak negara berkembang, fakta-fakta berikut umumnya berlaku dalam pengumpulan limbah padat:

1. Pengumpulan limbah padat dan penyapuan jalan sering sangat tidak efisien dan tingkat layanannya sangat rendah;
2. Para pekerja sering kali sangat tidak termotivasi, tidak terlatih dan memperoleh gaji yang sangat rendah;
3. Para pekerja pengumpul sampah sering diperlengkapi dengan peralatan yang sudah kuno atau hampir tidak berfungsi dengan tidak disertai dengan peralatan cadangan untuk mempertahankan tingkat layanan yang sesuai;
4. Rute-Rute pengumpulan sampah sering tidak mengimbangi perkembangan kota yang cepat;
5. Terdapat perbedaan yang nyata antara tingkat layanan pengumpulan sampah di daerah miskin dan di daerah yang lebih kaya,
6. Penghasil limbah padat sering kali harus membawa limbah padatnya ke tempat yang jaraknya jauh menuju bak sampah yang sering sulit untuk digunakan dan kelebihan kapasitas karena tidak diangkut secara memadai.
7. Kegiatan pengumpulan limbah padat di negara-negara berkembang sering mencakup keterlibatan yang dominan dari sektor informal, seperti usaha kecil atau orang-orang miskin yang menggantungkan hidupnya pada bahan-bahan yang diperoleh dari sampah baik di sistem pengumpulan limbah padat maupun di tempat pembuangan akhir.
8. Penggunaan kendaraan bertenaga manusia seperti gerobak sampah yang ditarik manusia atau hewan merupakan hal yang biasa terjadi.

Konfigurasi Alternatif untuk Pengumpulan dan Pemindahan Limbah Padat – Terdapat berbagai cara untuk mengumpulkan limbah padat; yang sebagian berfokus pada titik-titik hubung alternatif antara para penghasil sampah dengan titik masuk sampah mereka ke dalam program pengumpulan sampah formal. Faktor-Faktor berikut memiliki dampak langsung pada pilihan sistem pengumpulan sampah untuk setiap situasi atau lokasi tertentu:

1. **Tingkat produksi limbah padat** – Tingkat produksi limbah padat memiliki dampak yang signifikan terhadap sistem pengumpulan limbah padat dan pilihan-pilihan teknisnya (kendaraan, bak sampah, dll.). Semakin kaya suatu masyarakat, semakin tinggi tingkat produksi limbah padatnya. Tingkat produksi limbah padat rata-rata di negara-negara berkembang berkisar antara 0,3 sampai dengan 0,5 kilogram per kapita per hari.
2. **Kepadatan limbah padat** – Kepadatan limbah padat bervariasi tergantung pada tingkat kesejahteraan masyarakatnya dan cara penanganan dan penyimpanan sampah. Limbah padat di negara-negara berkembang biasanya padat (berkisar antara 300 sampai dengan 500 kg/m^3) karena kandungan organiknya tinggi. Truk pemadat biasanya dirancang untuk memadatkan sampah ringan menjadi sekitar 100 sampai 400 kg/m^3. Oleh karena itu, negara-negara berkembang mungkin memerlukan pemadatan dalam jumlah kecil atau tidak sama sekali dalam sistem pengumpulan limbah padat dibandingkan dengan sampah yang biasanya dihasilkan di negara-negara maju. Hal ini dapat membuat kendaraan pengumpul sampah yang secara teknis rumit atau stasiun pengangkutan sampah yang dilengkapi dengan alat pemadat seperti yang terdapat di negara-negara maju menjadi berkurang manfaatnya.

3. **Kondisi pengangkutan –** Kondisi jalan, kepadatan lalu lintas dan jarak angkut memiliki pengaruh yang signifikan terhadap pengumpulan limbah padat dan pilihan kendaraan pengangkut.
   Terdapat empat pendekatan pengumpulan limbah padat dasar primer yang tersedia bagi pemerintah atau organisasi kemasyarakatan untuk mencapai pengumpulan limbah padat primer, yaitu:
   a. Pengumpulan sampah bersama,
   b. Pengumpulan sampah per blok (juga disebut pengumpulan sampah secara tepat waktu),
   c. Pengumpulan sampah pinggir jalan/gang, dan
   d. Pengumpulan sampah dari rumah-ke-rumah.

Dalam pengumpulan sampah bersama, tempat publik ditetapkan sebagai titik pengumpulan sampah bersama dan digunakan secara bersama-sama oleh masyarakat untuk pengumpulan limbah padat. Dalam pengumpulan limbah padat per blok, kendaraan pengumpul limbah padat berhenti pada tempat tertentu dan para penghasil limbah padat mengantarkan sampah mereka ke kendaraan tersebut pada waktu pengumpulan sampah yang telah ditentukan. Dalam pengumpulan sampah pinggir jalan, para pemilik rumah mengeluarkan bak sampah mereka yang nantinya akan mereka ambil kembali setelah pengumpulan sampah selesai dilakukan. Dalam pengumpulan sampah dari rumah-ke-rumah, pengumpul sampah memasuki pekarangan rumah untuk mengumpulkan sampah.

Sebagaimana diperkirakan, pilihan pendekatan dalam pengumpulan sampah akan mempengaruhi kesesuaian sistem pengumpulan sampah bagi masyarakat. Sayangnya, sebagaimana halnya dengan banyak kasus yang terjadi, peningkatan kesesuaian sering diartikan peningkatan biaya. Berbagai kelebihan dan kekurangan dari setiap pendekatan yang biasanya digunakan adalah sebagai berikut:

Pengumpulan limbah padat bersama – Salah satu aspek penting dari penerapan pendekataan pengumpulan limbah padat bersama adalah keputusan tentang di mana bak sampah ditempatkan. Titik-Titik tersebut dapat terdiri dari sudut-sudut jalan, beberapa lokasi di jalan-jalan yang berpenduduk padat, atau di pinggiran lingkungan atau desa yang mudah dijangkau oleh para penghasil limbah padat maupun kendaraan pengumpul sampah.

Gambar 3 – Pembakaran pada Kontainer Bersama

Salah satu kelebihan utama dari titik pengumpulan limbah padat bersama adalah bahwa titik tersebut memungkinkan suatu rumah tangga secara potensial selalu memiliki akses ke tempat

pembuangan setiap saat mereka inginkan. Sebaliknya, apabila suatu titik pengumpulan limbah padat bersama hanya mendapat sedikit perhatian dari orang-orang yang bertanggung jawab atas pengumpulan limbah padat dari tempat tersebut, maka bak sampahnya dapat kelebihan kapasitas dan menyebabkan berbagai masalah seperti bau tidak enak dan serangga. Dalam beberapa kasus, penduduk di dekat titik-titik pengumpulan limbah padat bersama membakar limbah padat untuk mengurangi bau tidak enak atau serangga. Hal ini pada gilirannya akan meningkatkan risiko kesehatan yang buruk terhadap lebih banyak penduduk sebagai akibat dari kepulan asap dari sampah yang dibakar tersebut.

Praktik yang baik dalam perancangan tempat pengumpulan limbah padat bersama mengharuskan agar para pengelola limbah padat memahami benturan yang mungkin timbul di antara kebutuhan untuk mencapai kenyamanan bagi masyarakat dan strategi yang diperlukan untuk menjaga kebersihan dan kesehatan di sekitar bak sampah bersama. Para pengelola juga harus membuat strategi tentang cara bagaimana mengendalikan pemulung, bau tidak enak, binatang dan serangga yang mempengaruhi kondisi di sekitar bak sampah. Praktik yang sehat mensyaratkan adanya jumlah bak sampah yang memadai yang tersebar di titik-titik

pengumpulan limbah padat yang sesuai. Bak-Bak sampah tersebut harus mudah digunakan bahkan oleh anak-anak sekalipun yang sering diminta oleh orang tua mereka untuk membuang limbah padat ke titik pengumpulan sampah bersama. Harus terdapat jumlah bak sampah yang memadai agar para penghasil sampah tidak perlu menempuh jarak yang terlalu jauh untuk mencapai satu titik pengumpulan limbah padat tertentu. Praktik yang baik juga mensyaratkan bahwa para pengelola program berkomitmen untuk mengumpulkan sampah dengan frekuensi yang tinggi dan membersihkan tumpahan yang mungkin terjadi karena alasan apapun. Apabila titik-titik pengumpulan sampah tidak memadai dan tidak dirawat dengan baik, maka penegakan peraturan tentang limbah padat mungkin perlu untuk memastikan bahwa para penghasil sampah memenuhi kewajibannya untuk menggunakan titik-titik pengumpulan sampah.

Gambar 4 – Kontainer Tidak Terlayani Dengan Baik – Terdapat Sampah Terbakar

Kelebihan dan kekurangan utama dari pendekatan pengumpulan sampah bersama adalah sebagai berikut:

Kelebihan:

1. Penimbunan sampah ke dalam bak sampah bersama merupakan cara yang termurah dari berbagai praktik-praktik pengumpulan limbah padat primer.
2. Metode ini memerlukan pekerja pengumpul limbah padat yang lebih sedikit dibandingkan dengan metode lainnya.

Kekurangan:

1. Penduduk terganggu kenyamanannya karena harus membawa sampahnya ke titik pengumpulan sampah.
2. Terdapat peningkatan risiko cidera terhadap penduduk.
3. Pembuangan sampah/ pemulungan yang melanggar aturan mungkin terjadi yang mengarah kepada penimbunan sampah di dekat bak sampah.

Pengumpulan Limbah padat Pinggir Jalan/Gang – Metode pengumpulan sampah ini sangat umum di negara-negara maju. Kelebihan dan kekurangan dari pendekatan ini adalah sebagai berikut:

Kelebihan:

1. Tenaga pengumpul sampah dengan peralatan yang tepat dapat dengan cepat berpindah dari perhentian pengumpulan limbah padat yang satu ke perhentian yang lainnya.
2. Tenaga pengumpul sampah tidak memasuki properti pribadi.
3. Metode ini lebih murah dibandingkan dengan pengumpulan sampah di pekarangan belakang karena metode ini umumnya memerlukan waktu dan personel pengumpul sampah yang lebih sedikit untuk mengumpulkan sampah. dan
4. Pendekatan ini dapat disesuaikan dengan peralatan pengumpul sampah otomatis dan semi otomatis.

Kekurangan:

1. Pada hari-hari pengumpulan sampah, bak sampah dapat dilihat dari jalan.
2. Hari-hari pengumpulan sampah harus mengikuti jadwal yang konsisten dan dapat diandalkan.
3. Penduduk bertanggung jawab untuk menaruh bak sampah di titik pengumpulan limbah padat yang tepat.
4. Biaya untuk tingkat layanan ini mungkin terlalu mahal untuk daerah dengan sumber daya yang terbatas.

Pengumpulan Limbah padat per Blok – Metode pengumpulan limbah padat ini memungkinkan adanya peningkatan yang baik atas sumber daya teknis yang terbatas. Kelebihan dan kekurangan dari pendekatan ini adalah sebagai berikut:

Kelebihan:

1. Struktur pengumpulan limbah padat yang tetap telah dihilangkan.
2. Tenaga pengumpul limbah padat dapat membersihkan lokasi pengumpulan limbah padat per blok pada saat mereka menunggu sampah yang akan dibawa ke lokasi tersebut.
3. Sampah ditempatkan ke dalam kendaraan pengumpul sampah secara langsung oleh para penghasil sampah dan dengan demikian menghilangkan kebutuhan akan tempat penimbunan bersama

Kekurangan:

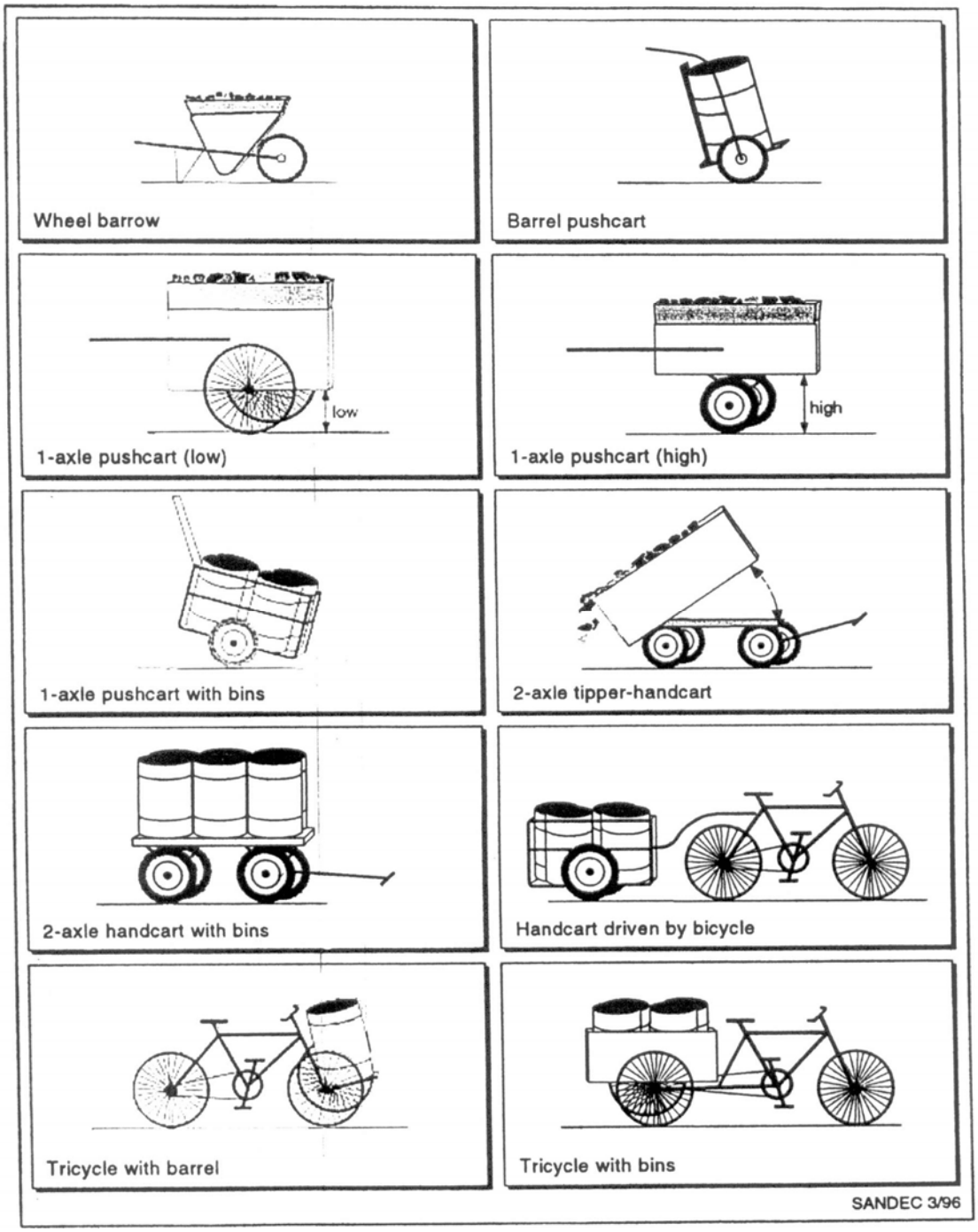
1. Diperlukan koordinasi yang sangat erat di antara sistem pengumpulan sampah primer dan sistem pengangkutan sekunder.
2. Para penghasil limbah padat harus menyimpan sampah mereka sampai tiba waktunya untuk membawa sampah ke lokasi pengumpulan sampah per blok.
3. Pendekatan ini mengharuskan agar seseorang berada di rumah pada saat truk tiba di titik pengumpulan sampah untuk mengumpulkan sampah.

Berikut ini adalah kesimpulan-kesimpulan umum berkaitan dengan biaya keseluruhan dari berbagai jenis sistem pengumpulan.

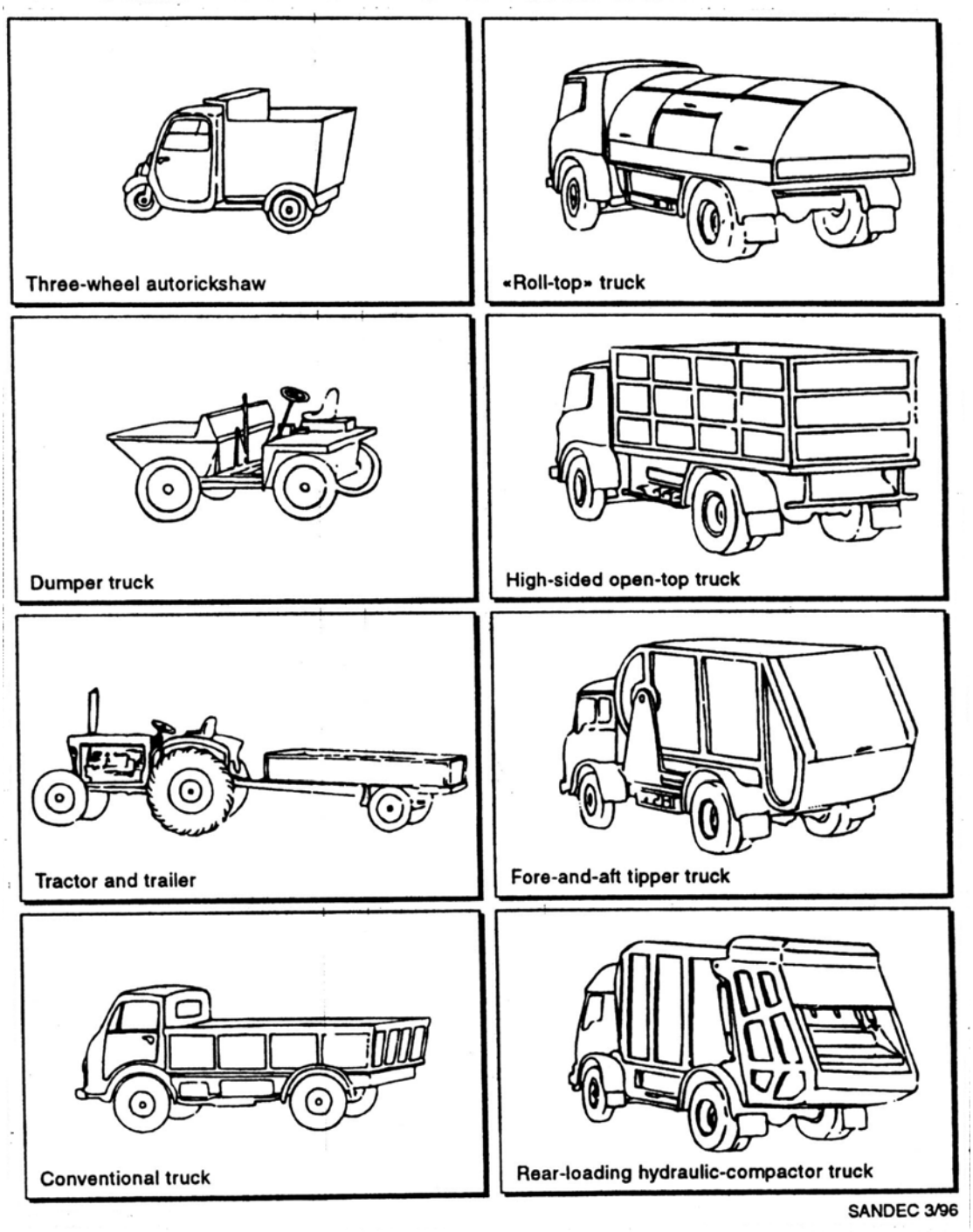
1. Sistem penampungan sampah bersama mungkin menawarkan biaya pengumpulan sampah yang paling rendah dan paling fleksibel di sebagian besar negara berkembang.
2. Pengumpulan per blok dengan selang waktu yang tetap menawarkan biaya pengumpulan limbah padat yang rendah dan menghindari berbagai masalah yang muncul yang ada pada sistem penampungan limbah padat bersama atau pengumpulan sampah pinggir jalan tetapi memerlukan pelaksanaan yang konsisten dan dapat diandalkan agar berhasil.
3. Pengumpulan limbah padat dari rumah ke rumah atau pinggir jalan/ gang dengan menggunakan kendaraan bermotor dan tenaga pengumpul limbah padat biasanya akan menjadi sistem yang paling mahal tetapi juga merupakan sistem yang paling nyaman bagi para penghasil sampah.

Kendaraan Pengumpul Primer – Para pengelola limbah padat harus memilih kendaraan yang sesuai dengan karakteristik daerah pelayanan pengumpulan limbah padat dan cara mereka menjalankan pengumpulan sampah. Kendaraan pengumpul primer dapat berupa gerobak atau kereta bertenaga otot hingga mesin pemadat sampah yang canggih. Ada sejumlah hal yang dapat mempengaruhi pemilihan kendaraan, antara lain 1) tingkat layanan yang diharapkan, 2) jumlah kru, 3) karakteristik rute pengumpulan sampah dan 4) hambatan anggaran. Truk angkut konvensional sering digunakan untuk mengumpulkan sampah.

Kelebihan dari truk ini adalah serbaguna dan tersedia di sebagian besar negara. Perbaikan dan perawatan tidak perlu dilakukan secara khusus (dan, oleh karena itu, lebih murah) dibandingkan dengan kendaraan yang dirancang hanya untuk keperluan mengumpulkan sampah.



Gambar 5 – Contoh Gerobak dan Sepeda Roda Tiga



Gambar 6 – Contoh Kendaraan Bermotor

Kendaraan pemadat sampah yang secara khusus dirancang untuk pengelolaan limbah padat biasanya digolongkan berdasarkan cara untuk memasukkan muatannya. Kendaraan tersebut digolongkan sebagai kendaraan yang muatannya dimasukkan dari belakang atau dari samping. Truk yang muatannya dimasukkan dari belakang paling sesuai untuk daerah-daerah dengan penduduk berjumlah besar dan di mana terdapat banyak dan sering ada titik pemberhentian

kendaraan pengumpul sampah. Cara pemuatan ini memungkinkan sampah di kedua sisi jalan atau gang dikumpulkan sekaligus. Kendaraan yang diisi dari samping paling sesuai untuk daerah-daerah padat penduduk di mana pengumpulan limbah padat dilakukan hanya di salah satu sisi jalan atau rute-rute pedesaan.

Gambar 7 – Truk Pengumpul Bak Terbuka

Dalam sebuah program ISWM yang efektif, limbah padat juga harus dikumpulkan dari lokasi-lokasi perdagangan dan industri, serta perumahan. Umumnya, sampah dari tempat perdagangan berbeda kuantitas dan komposisinya dengan sampah dari perumahan dan biasanya ditampung dalam bak-bak sampah sebelum diangkut yang biasanya oleh pihak swasta atau staf dari tempat yang menghasilkan limbah padat tersebut. Truk-truk yang muatannya dimasukkan dari belakang dan samping seperti yang digunakan untuk mengumpulkan limbah padat kota seringkali digunakan. Selain itu, truk yang muatannya dimasukkan dari depan dan truk buang (*drop-off*) juga lazim digunakan. Alat pemuat sampah dari depan dirancang untuk

Gambar 8 – Truk Pengumpul dengan Pemadat Front Loader

digunakan dengan bak-bak sampah yang secara khusus dirancang untuk digunakan dengan truk tersebut. Setelah truk tersebut diarahkan ke bak sampah, bak tersebut diambil oleh lengan-lengan hidrolik, diangkat melewati ruang pengemudi truk, dan isinya dituang ke sebuah wadah penampung di bagian atas dari badan pemadat sampah di bagian belakang truk.

Truk yang secara fisik dilengkapi dengan bak-bak sampah angkat-buang juga seringkali digunakan untuk mengumpulkan limbah padat dari kawasan industri dan perdagangan. Dalam hal ini, bak-bak sampah secara fisik diangkat, dibawa ke lokasi pembuangan atau pengolahan, dikosongkan, dan dikembalikan ke titik asal dengan truk yang sama. Ada dua jenis konfigurasi yang biasanya digunakan. Jenis dumpster memungkinkan bak sampah diangkat ke truk oleh lengan-lengan yang digerakkan secara hidrolik yang terpasang di dekat bagian belakang truk tersebut. Jenis lainnya menggunakan rangka miring yang menggerakkan bak sampah yang dilengkapi dengan roda naik dan turun dengan menggunakan rantai atau kabel. Dalam beberapa variasinya, kait yang digerakkan secara hidrolik digunakan untuk menarik bak sampah ke atas truk.

Gambar 9 – Kontainer Niaga

Gambar 10 – Truk Tilt Frame Roll-off

Berbagai contoh kendaraan-kendaraan yang digunakan untuk pengumpulan primer dan pengangkutan sekunder dapat dilihat pada halaman-halaman berikut. Beberapa kelebihan dan kekurangan dari jenis-jenis utama kendaraan pengumpul limbah padat dijelaskan di bawah ini:

Kendaraan bertenaga Manusia/ Hewan

Kelebihan:

1. Sesuai, khususnya di daerah-daerah padat penduduk dengan akses jalan yang minim atau jalan-jalan yang belum diaspal
2. Sesuai untuk permukiman liar dan di kawasan yang berat.
3. Sesuai untuk daerah-daerah di mana sampah yang harus dikumpulkan relatif sedikit dari banyak unit perumahan yang padat penghuninya.
4. Kendaraan semacam ini seringkali murah dan mudah dibuat dan dirawat.

Kekurangan:

1. Persepsi masyarakat bahwa penggunaan kendaraan semacam ini kuno dan tidak efisien.
2. Jangkauan perjalanan yang terbatas dan lambat.
3. Apabila kendaraan tersebut ditarik oleh hewan, kotoran hewan harus dibersihkan.
4. Sangat terpengaruh oleh kondisi dan paparan cuaca.
5. Lebih rentan terhadap penurunan efisiensi karena sifat hewan dan kesehatan para pengumpul sampah.

Gambar 11 – Gerobak yang Ditarik Keledai

Gambar 12 – Gerobak Bertenaga Manusia & Hewan

Truk tanpa pemadat

Kelebihan:

1. Cukup efisien apabila limbah padat umumnya basah atau padat
2. Praktis apabila tenaga kerja mahal
3. Praktis apabila hanya ada akses yang terbatas terhadap perawatan terampil untuk kendaraan yang lebih rumit
4. Rute-rute pengumpulan panjang dan relatif jarang penduduk
5. Truk kemungkinan secara luas tersedia dari sumber-sumber lokal sehingga mengurangi waktu tidak beroperasi karena perbaikan dan biaya perbaikan
6. Truk dapat dengan mudah melaksanakan sejumlah fungsi pengumpulan limbah padat yang berbeda.

Gambar 13 – Kendaraan Pengumpul Kecil

Gambar 14 – Dump Truk Terbuka

Kekurangan:

1. Muatan limbah padat seringkali harus ditutupi saat mengangkut sampah ke tempat pemindahan, pengolahan atau pembuangan untuk menghindari jatuhnya sampah dari truk ke jalan.
2. Beberapa truk tanpa alat pemadat sering tidak memiliki alat-alat otomatis untuk menurunkan sampah. Hal ini sangat memperpanjang waktu yang dibutuhkan untuk mengosongkannya.

3. Banyak pejabat pemerintah yang berpendapat bahwa sebuah program pengumpulan limbah padat yang modern dan efisien harus menyertakan kendaraan pemadat dan bahwa kendaraan tanpa pemadat menunjukkan efisiensi rendah.
4. Lembaga-lembaga donor cenderung menyarankan peralatan yang digunakan di negara-negara mereka sendiri dan mereka cenderung beranggapan bahwa truk pemadat menunjukkan uang pemberian mereka telah digunakan sebaik-baiknya.

Gambar 15 – Kompaktor yang Diisi dari Belakang

Gambar 16 – Kompaktor yang Diisi dari Samping

Truk pemadat – Truk ini merupakan standar dari praktik yang baik di sebagian besar negara maju yang mampu untuk menanggung biayanya. Truk ini biasanya dirancang secara khusus untuk keperluan pengumpulan limbah padat.

Kelebihan:

1. Memungkinkan limbah padat untuk dimasukkan baik dari belakang maupun dari samping kendaraan.
2. Memadatkan sampah ke tingkat kepadatan yang lebih tinggi dengan menggunakan penekan hidrolik atau mekanik sehingga meningkatkan jumlah sampah yang dapat diangkut sebelum membawanya ke tempat pembuangan.
3. Menyembunyikan sampah dari pandangan masyarakat sehingga menambah ketidak-terlihatan sistem pengumpulan.
4. Menghindari serangga hinggap di sampah setelah sampah tersebut dimasukkan ke dalam truk pemadat.

Kekurangan:

1. Biaya modal yang besar
2. Truk tersebut dirancang untuk keperluan yang khusus sehingga tidak dapat digunakan untuk keperluan lain.
3. Terdapat cukup banyak mekanisme mekanik yang membutuhkan perawatan khusus
4. Penggunaan bahan bakar tinggi mengakibatkan biaya operasi tinggi,
5. Membutuhkan jalan beraspal yang cukup lebar yang memungkinkan truk melewati atau berputar saat pengumpulan,
6. Sampah harus diletakkan dalam bak atau kantong sampah agar kru pengumpul dapat mengambilnya

3. MERANCANG SISTEM PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

3.1. PENJELASAN SECARA KHUSUS DARI SISTEM PENGUMPULAN LIMBAH PADAT YANG ADA

Titik awal perancangan sebuah sistem pengumpulan limbah padat yang efektif adalah penggambaran sifat dari sistem dan praktik-praktik yang telah ada. Berikut ini adalah sejumlah faktor yang harus dievaluasi sebelum menentukan perubahan atau perbaikan yang diperlukan pada sistem pengumpulan limbah padat.

3.1.1. Perkirakan jumlah dan komposisi limbah padat dalam daerah pelayanan

Walaupun jumlah dan komposisi limbah padat secara keseluruhan merupakan hal yang penting dalam merancang tempat pembuangan sampah, rancangan sistem pengumpulan dan pengangkutan limbah padat harus memperhitungkan jumlah limbah padat yang dihasilkan dalam setiap bagian dari daerah pelayanan pengumpulan atau dalam daerah layanan yang dilayani oleh setiap stasiun pemindahan. Sebagai contoh, apabila setiap kecamatan di Manado bertanggung jawab atas pengumpulan sekunder, mereka harus mengetahui jumlah limbah padat yang harus mereka tangani untuk mengetahui di mana saja titik-titik pengumpulan sampah bersama harus ditempatkan dan sumber daya teknis (truk dan staff) apa saja yang dibutuhkan untuk mengatasi titik-titik pengumpulan sampah tersebut. Demikian pula, petugas kelurahan yang bertanggung jawab atas pengumpulan primer perlu mengetahui jumlah sampah yang harus mereka kumpulkan.

3.1.2. Tentukan ciri-ciri fisik wilayah layanan pengumpulan limbah padat

Ciri-ciri fisik (topografi, jaringan jalan, akses ke titik-titik pengumpulan limbah padat, dsb.) dari wilayah layanan pengumpulan limbah padat primer memiliki pengaruh yang besar dalam rancangan program pengumpulan sampah. Kemudahan akses jalan dalam wilayah pengumpulan sampah merupakan hal yang sangat penting dalam menentukan jenis kendaraan yang dapat digunakan. Pola-pola transportasi umum dalam daerah pelayanan menentukan jalan-jalan mana yang sulit dilalui selama waktu-waktu lalu lintas padat.

3.1.3. Buat inventaris aset

Para perencana penanganan limbah padat perlu membuat inventaris tentang komponen-komponen dari sistem pengumpulan limbah padat kota secara keseluruhan. Inventaris ini harus mencakup seluruh aset fisik (truk, bak sampah, dsb.) dan personil yang dikerahkan untuk proses pengumpulan limbah padat. Inventaris ini juga perlu memasukkan aset-aset sementara yang secara berkala dipakai dalam proses pengumpulan. Apabila terdapat bak sampah atau bangunan bersama yang digunakan, jumlah dan lokasinya harus diperlihatkan dalam rencana sistem pengumpulan limbah padat yang menunjukkan cakupan penempatan bak sampah dan daerah yang dilayani.

3.1.4. Tentukan rute-rute pengumpulan yang telah ada

Apabila yang diterapkan adalah pengumpulan pinggir jalan, perlu dibuat sebuah peta rute yang telah ada untuk menunjukkan cakupan dan konfigurasi struktur rute pengumpulan limbah padat. Dalam pengumpulan pinggir jalan, peta tersebut harus menyertakan pola tetap perjalanan staf pengumpul sampah melalui daerah-daerah pelayanan mereka. Meskipun tidak terlalu penting dalam skema tempat pengumpulan sampah bersama, peta rute tetap perlu ditentukan agar dapat dimaksimalkan.

3.1.5. Tentukan efektifitas sistem pengumpulan yang telah ada

Sebuah sistem pengumpulan sampah yang efisien mengumpulkan sebanyak mungkin sampah dengan jumlah pekerja dan pengeluaran sekecil mungkin dan dalam waktu sesingkat mungkin. Efektifitas sistem pengumpulan sampah yang telah ada dapat dievaluasi dengan berbagai cara. Apabila sistem yang digunakan adalah sistem pengumpulan bersama, tumpukan sampah di luar bak sampah dapat mengindikasikan bahwa bak sampah tersebut tidak cukup sering dibersihkan.

Produktifitas kru merupakan ukuran penting dalam efisiensi pengumpulan limbah padat. Faktor-faktor yang mempengaruhi produktifitas kru antara lain adalah struktur rute, tingkat layanan, peralatan pengumpulan limbah padat dan sifat masing-masing anggota kru. Kendaraan pengumpul limbah padat dapat mempengaruhi produktifitas kru dengan beberapa faktor seperti tempat pengisian sampah, tinggi pengisian, kapasitas kendaraan, kepadatan pemadatan, dan usia/ kondisi truk. Faktor masing-masing anggota kru yang dapat mempengaruhi produktifitas antara lain adalah usia, sikap mereka terhadap pekerjaan, dan kesehatan. Cara-cara dasar untuk mengukur produktifitas kru adalah dengan mengamati proses pengumpulan agar dapat menentukan tingkat kinerja praktis yang dapat diharapkan dari kru pengumpul secara teratur dan terukur. Pengamatan tentang waktu seringkali diperlukan untuk mengetahui bagaimana seorang kru pengumpul sampah menggunakan waktunya untuk melaksanakan tugas-tugasnya. Tujuannya adalah untuk memaksimalkan waktu yang benar-benar digunakan di rute-rute pengumpulan limbah padat dan mengurangi waktu yang dihabiskan untuk kegiatan-kegiatan yang kurang produktif, seperti perjalanan ke dan dari tempat pembuangan akhir.

3.1.6. Identifikasikan kekurangan sistem pengumpulan

Karena pelayanan pengumpulan limbah padat memiliki sifat yang mudah terlihat, kekurangan dari sistem tersebut dapat ditentukan berdasarkan jumlah tumpukan sampah di luar komponen-komponen pengumpulan. Keluhan merupakan indikator lainnya tentang kinerja dan kelemahan sistem. Jumlah kerusakan kendaraan pengumpul sampah dan dampaknya pada tingkat pelayanan dapat pula menjadi indikasi tentang kelemahan sistem.

3.1.7. Identifikasikan biaya pengumpulan limbah padat yang sebenarnya melalui metode akuntansi biaya penuh

Pelaksanaan yang efektif mengharuskan agar pengelola limbah padat memahami seluruh biaya yang berkaitan dengan pengelolaan limbah padat. Dalam pengumpulan limbah padat, biaya keseluruhan harus mencakup seluruh komponen biaya untuk peralatan dan personel baik yang purna waktu maupun sementara. Dengan analisis yang tepat tentang biaya penuh dalam

pengumpulan sampah yang berlaku, penghematan yang dapat diwujudkan dengan melakukan peningkatan efisiensi pengumpulan limbah padat dan retribusi yang perlu dikenakan untuk menutupi biaya dapat diperhitungkan.

3.2. TENTUKAN PERALATAN PENGUMPULAN LIMBAH PADAT YANG DIPERLUKAN

Dalam bentuk yang paling sederhana, pengumpulan limbah padat terdiri atas seorang pengumpul atau kru pengumpul sampah yang menelusuri sebuah wilayah pelayanan pengumpulan limbah padat dengan atau tanpa kendaraan untuk mengumpulkan limbah padat dari penghasil sampah atau bak sampah bersama. Kendaraan yang digunakan dalam proses ini berkisar dari kendaraan kecil dan sederhana hingga truk pemadat otomatis yang besar dan rumit untuk pengumpulan pinggir jalan seperti yang dipakai di banyak kota industri. Kendaraan pengumpul sampah yang digunakan di daerah manapun harus sesuai dengan lahan dan jalan yang harus dilaluinya, kepadatan daerah pelayanan, jenis dan kuantitas limbah padat yang harus dikumpulkan, kekuatan dan kebiasaan kerja dari kru pengumpul sampah, dan jarak ke lokasi pembuangan. Berikut ini adalah prinsip-prinsip penting yang harus diterapkan dalam pemilihan kendaraan.

1. Kendaraan yang dipilih sebaiknya yang menggunakan energi dan kerumitan teknis minimal untuk mengumpulkan sampah dengan efisien.
2. Peralatan buatan lokal, rancangan kendaraan tradisional dan keahlian lokal perlu digunakan dalam pengadaan kendaraan pengumpul.
3. Peralatan yang dipilih sebaiknya yang dapat diperbaiki di dalam negeri dan yang suku cadangnya tersedia.
4. Kendaraan yang menggunakan tenaga manusia atau hewan atau truk kecil perlu dipertimbangkan sebagai kendaraan pengumpul primer di daerah padat atau di daerah dengan lahan berbukit-bukit atau di permukiman liar.
5. Truk tanpa pemadat atau truk angkut dapat dipertimbangkan untuk daerah di mana penduduk yang dilayani tersebar atau yang sampahnya padat atau daerah yang sangat memerlukan keserba-gunaan.
6. Sistem hibrida (campuran) dapat dipertimbangkan untuk daerah di mana kendaraan kecil atau kendaraan yang menggunakan tenaga manusia digunakan untuk mengantarkan muatan ke kendaraan yang lebih besar dalam rute pengumpulan.
7. Truk pemadat perlu dipertimbangkan untuk daerah perkotaan industri yang jalannya telah diaspal, cukup lebar sehingga truk pemadat dapat digunakan secara efektif dan di mana rute pengumpulan melayani banyak penghasil sampah dan sampah tidak padat atau terlalu basah.

Gambar 17 – Kru Pengumpulan dengan Truk Bak Terbuka

Merancang sebuah sistem pengumpulan limbah padat berarti mengambil keputusan tentang metode pengumpulan, jenis dan jumlah kendaraan yang akan digunakan dan jumlah tenaga kerja yang harus dipekerjakan. Di sebagian besar negara berkembang, tingkat upah rendah sementara biaya kendaraan dan peralatan tinggi. Oleh karena itu, sistem pengumpulan primer yang menghasilkan produktifitas kendaraan tinggi bahkan dengan mengorbankan produktifitas pekerja seringkali terbukti paling hemat.

Pada Umumnya, apabila jarak pengangkutan tidak lebih dari 20 kilometer, kendaraan-kendaraan tanpa pemadat dan semi-pemadat yang memiliki tenaga yang cukup kuat digunakan untuk mengangkut limbah padat langsung ke lokasi pembuangan. Optimalisasi jumlah kru sehingga meminimalkan total biaya pekerja dan kendaraan merupakan cara yang paling baik dalam memaksimalkan produktifitas kendaraan. Produktifitas ini dapat dipengaruhi oleh apakah stasiun-stasiun pemindahan (dibahas kemudian dalam dokumen ini) dilaksanakan sebagai bagian dari sistem pengumpulan secara keseluruhan.

3.3. TENTUKAN PERSONIL PENGUMPULAN LIMBAH PADAT YANG DIBUTUHKAN

Salah satu faktor mendasar dalam menentukan biaya dan efisiensi program pengumpulan limbah padat adalah jumlah, kemampuan, dan motivasi dari staf pengumpul sampah. Jumlah optimal kru bergantung pada biaya tenaga kerja dan peralatan, metode pengumpulan (pinggir jalan, bak sampah bersama, dsb.) dan sifat rute. Analisis tentang praktik yang sedang berlangsung juga akan membantu menentukan tingkat optimal penugasan staf yang dibutuhkan untuk memberikan tingkat pelayanan yang baik tanpa memperhatikan konfigurasi pengumpulan sampah yang digunakan.

Tabel 1 – Bagan Perbandingan antra Bak Sampah Pusat dengan Fasilitas Pemindahan

Bak Sampah Terpusat	Fasilitas Pemindahan
Melayani suatu daerah tertentu dari sebuah kota atau desa	Melayani beberapa kota dan desa yang berbatasan
Mungkin terletak dalam batas-batas sebuah kota atau desa	Mungkin terletak di luar batas kota dan desa
Dimungkinkan untuk mengubah lokasinya berdasarkan prinsip coba-coba	Pengubahan lokasinya akan menimbulkan biaya untuk membangun fasilitas-fasilitas yang dirancang baru
Truk mengangkutnya "sebagaimana adanya" ke tempat pembuangan akhir dan kembali ke lokasi yang sama berdasarkan jadwal yang diatur semula	Tergantung pada rancangannya, dapat atau tidak dapat memuat bak-bak besar yang akan diangkut ke tempat pembuangan akhir
Tidak perlu menimbang sampah yang datang	Perlu menimbang sampah yang datang (karena sampah berasal dari beberapa pemerintah daerah)
Pemerintah daerah bertanggung jawab untuk mengangkut limbah padat ke bak terpusat pada waktu-waktu tertentu.	Pemerintah daerah bertanggung jawab untuk mengangkut limbah padat ke fasilitas ini, baik pada waktu tertentu atau setiap waktu tergantung pada bentuknya (misalnya, menyediakan mesin pengukur berat dan operatornya secara terus menerus)
Limbah padat diangkut ke bak sampah baik oleh pekerja secara manual atau diangkut dengan kendaraan (misalnya traktor-trailer)	Limbah padat diangkut hanya oleh kendaraan pengangkut

3.4. TENTUKAN RUTE PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

Daerah Pelayanan Pengumpulan Limbah padat – Daerah pelayanan pengumpulan limbah padat adalah daerah yang masuk dalam kewenangan sebuah instansi pemerintah atau perusahaan swasta dan seringkali dibatasi oleh batasan-batasan politik atau geografis. Setiap daerah pelayanan kecamatan di Manado, sebagai contoh, ditentukan oleh batas-batas kecamatan di dalam kota.

Untuk penentuan aspek-aspek teknis suatu sistem pengumpulan limbah padat, batasan-batasan ini, serta lokasi dan rute ke lokasi pembuangan, stasiun pemindahan atau sarana pengolahan sampah perlu ditandai pada peta daerah pelayanan secara keseluruhan yang dapat digunakan untuk berbagai keperluan perencanaan dan perancangan. Dengan membagi sebuah daerah pelayanan (bila cukup besar sehingga hal tersebut dapat dilakukan) menjadi wilayah-wilayah pembuangan sampah untuk pelayanan sehari-hari akan menciptakan wilayah-wilayah pengumpulan limbah padat. Agar sistem menjadi seimbang untuk menjaga produktifitas tinggi, jumlah rata-rata kepala keluarga yang ditentukan untuk setiap wilayah pengumpulan sebaiknya hampir sama.

Setiap wilayah dapat dibagi menjadi beban kerja harian optimal untuk setiap kendaraan dan kru pengumpul. Pemecahan ini dimaksudkan untu menjamin bahwa bak-bak sampah bersama dibersihkan secara terprogram dan konsisten sesuai dengan standar kinerja yang telah ditentukan. Penetapan wilayah-wilayah pengumpulan sampah memungkinkan pelaksana pengelolaan limbah padat untuk memperkirakan jumlah dan ukuran truk yang dibutuhkan untuk mengumpulkan sampah di setiap wilayah, mengevaluasi kinerja kru (juga sebagai cara untuk secara teratur memeriksa kinerja sistem secara terus menerus) dan untuk menyeimbangkan atau menyama-ratakan beban kerja antar wilayah.

Pertimbangan utama dalam pengembangan wilayah-wilayah yang seimbang dalam pengumpulan pinggir jalan adalah produktifitas kru dan waktu keliling (*on-route*). Peningkatan pada salah satu dari kedua faktor tersebut akan menurunkan biaya yang berkaitan dengan pengumpulan sampah. Waktu keliling adalah waktu produktif dan perlu dimaksimalkan agar memungkinkan kru pengumpul mengumpulkan sampah di sebanyak mungkin titik pemberhentian (atau bak sampah bersama) dalam hari kerja yang tersedia. Pada Umumnya, variabel utama dalam waktu keliling adalah waktu yang benar-benar digunakan untuk berjalan ke dan dari lokasi pembuangan. Bila waktu ini berlebihan, pembuatan stasiun-stasiun pemindahan perlu dipertimbangkan untuk memastikan bahwa kru pengumpul menghabiskan sebanyak mungkin waktu untuk benar-benar mengumpulkan sampah.

Rute Pengumpulan Limbah padat - Dalam sebuah wilayah pengumpulan sampah, susunan pengumpulan sampah dibuat dalam bentu rute. Rute adalah suatu jalur yang dilalui oleh sebuah kendaraan pengumpul untuk mengumpulkan limbah padat dalam satu hari. Tujuan penyusunan rute adalah untuk mengarahkan kendaraan pengumpul melalui daerah tersebut sehingga meminimalisir waktu yang terbuang. Penyusunan rute dapat diterapkan terhadap truk-truk dan kru yang melaksanakan pengumpulan sampah pinggir jalan serta terhadap truk dan kru yang melayani bak-bak sampah bersama.

Dalam analisis penyusunan rute, harus dibuat sebuah peta yang menunjukkan jumlah dan jenis tempat pemberhentian kendaraan pengumpul sampah per bagian jalan atau jumlah dan lokasi bak sampah bersama. Apabila yang dipertimbangkan adalah metode pengumpulan pinggir jalan, peta tersebut harus juga menunjukkan jalur-jalur jalan dengan ciri-ciri khususnya,

seperti jalan buntu atau terutama sekali jalan-jalan yang padat. Setiap bagian jalan harus menunjukkan arah truk dengan tanda panah dan apakah limbah padat dapat diambil pada satu atau kedua sisi jalan dengan sekali jalan atau apakah truk pengumpul harus melakukannya dengan dua kali jalan untuk mengumpulkan limbah padat dari masing-masing sisi jalan.

Dalam pengumpulan sampah pinggir jalan, rute dapat ditetapkan dengan berbagai metode yang berbeda-beda seperti 1) metode coba-coba, 2) analisis komputer, atau 3) metode heuristik. Pendekatan heuristik mencakup penerapan pengalaman, akal sehat, dan aturan kasar tertentu (atau "heuristik") untuk mencari pemecahan yang dapat diterima, tetapi tidak perlu pemecahan yang terbaik, untuk penentuan rute pengumpulan sampah.

Penentuan Rute Secara Heuristik dikembangkan oleh Badan Perlindungan Lingkungan Hidup Amerika Serikat (*Environmental Protection Agency*) pada pertengahan tahun 1970-an sebagai kompromi antara pendekatan coba-coba dan pendekatan komputer. Walaupun penentuan rute secara heuristik lebih tepat dibandingkan dengan metode coba-coba, penentuan rute ini memerlukan jangka waktu yang lebih pendek untuk persiapan dan sumber-sumber teknis dibandingkan dengan analisis komputer. Metode heuristik untuk penentuan rute pengumpulan sampah merupakan

alat yang bagus bagi pengelola limbah padat untuk menganalisis pengumpulan sampah pinggir jalan. Metode heuristik menggunakan pedoman khusus pembuatan rute sebagai berikut:

1. Rute tidak boleh terpecah-pecah atau saling tumpang tindih. Masing-masing rute harus padat yang terdiri atas bagian-bagian jalan yang dikelompokan dalam daerah geografis yang sama
2. Waktu pengumpulan dan pengangkutan harus secara wajar tetap untuk setiap rutenya.
3. Rute pengumpulan harus dimulai dari tempat sedekat mungkin dari garasi atau tempat asal truk.
4. Dalam rute tersebut, belokan ke kiri lebih baik dibandingkan dengan belokan ke kanan karena jauh lebih efisien.
5. Pada jalan-jalan yang sangat padat lalu lintasnya, pemungutan limbah padat tidak boleh dilakukan pada jam-jam sibuk.
6. Pada jalan-jalan satu arah, pemungutan sebaiknya dilakukan mulai dari hulu jalan yang dilakukan secara berputar.
7. Jalan-jalan buntu harus dianggap sebagai bagian dari jalan yang bersimpangan dengan jalan buntu tersebut. Sampah harus dipungut dengan cara memajukan kendaraan hingga ke ujung, mundur hingga ke ujung atau dengan berbalik arah. Belokan-belokan ke kanan dapat dikurangi dengan cara mengumpulkan limbah padat pada jalan-jalan buntu ketika letaknya ada di sebelah kiri truk.
8. Pengumpulan limbah padat pada bukit-bukit yang curam harus dilakukan pada kedua sisi jalan ketika truk bergerak menuruni bukit demi keselamatan, kemudahan pemuatan, kecepatan pengumpulan, penggunaan kendaraan, dan penghematan bahan bakar.
9. Tempat-tempat yang lebih tinggi harus ditempatkan pada awal rute.
10. Pengumpulan limbah padat dari salah satu sisi jalan dalam sekali jalan sebaiknya dilakukan berlawanan arah jarum jam ke arah kiri mengelilingi blok.
11. Pengumpulan limbah padat dari kedua sisi jalan pada waktu yang sama pada umumnya lebih baik ditentukan rutenya dengan jalur jalan yang panjang terlebih dahulu sebelum memutar berlawanan arah jarum jam.
12. Pola-pola penentuan rute khusus harus diterapkan untuk jenis-jenis blok tertentu di dalam suatu rute.

Analisis ini memberikan dasar bagi pelaksana pengelolaan limbah padat untuk secara terus menerus mengkaji ulang susunan rute mereka untuk menentukan peningkatan apa yang dapat dilakukan terhadap tingkat pelayanan atau penghematan biaya bagaimana yang dapat dicapai dengan membuat perubahan-perubahan. Analisis yang baru dan perubahan pada konfigurasi (penusunan kembali rute) rute-rute pengumpulan sampah harus dipertimbangkan apabila terdapat perubahan yang penting dalam sistem pengumpulan sampah. Parubahan-perubahan tersebut antara lain adalah:

1. Frekuensi pengumpulan;
2. Titik-titik pengumpulan (pinggir jalan, gang, halaman belakang atau bak sampah bersama);
3. Jumlah petugas;
4. Ukuran truk atau tipe peralatan;
5. Lokasi pengolahan dan tempat pembuangan akhir;
6. Jenis bak-bak penyimpanan yang digunakan; atau
7. Jumlah pelayanan.

3.5. TENTUKAN FREKUENSI DAN JADWAL PENGUMPULAN YANG OPTIMAL

Frekuensi pengumpulan sampah merupakan faktor yang penting dalam menentukan biaya pengumpulan dan efisiensi. Di banyak kota-kota tropis, pengumpulan di pinggir jalan dilakukan sebanyak satu kali sehari. Di kebanyakan negara-negara industri, pengumpulan sampah dilakukan sekali atau, paling banyak, dua kali seminggu. Salah satu keuntungan dari bak sampah bersama adalah bahwa penghasil sampah dapat mengangkut sampah ke bak tersebut pada setiap waktu. Sehingga, penyimpanan sampah di rumah tidaklah menjadi masalah. Akan tetapi, masalah dapat timbul apabila jadwal pengumpulan untuk bak-bak sampah bersama tidak memadai sehingga bak-bak sampah tersebut dipergunakan untuk pembuangan sampah. Praktik yang baik dalam hal frekuensi pengumpulan harus mencakup analisis tentang kebutuhan dan keinginan masyarakat, risiko kesehatan yang berkaitan dengan rendahnya frekuensi pengumpulan sampah, pentingnya masalah-masalah gangguan seperti bau dan, akhirnya, perlunya penjadwalan pengumpulan sampah pada saat-saat ketika jalan-jalan tidak padat. Proses pendidikan masyarakat harus membantu untuk mengatasi kebutuhan agar masyarakat memahami bahwa peningkatan layanan, seperti pengumpulan sampah yang lebih sering, akan meningkatkan biaya dan keharusan mereka untuk menyediakan uang untuk menutup biaya-biaya tersebut.

3.6. EVALUASI DAMPAK DARI PEMINDAHAN BIAYA KESELURUHAN DAN EFISIENSI PENGUMPULAN LIMBAH PADAT

Semua jenis kendaraan pengumpul limbah padat memiliki radius operasi di mana kendaraan-kendaraan tersebut hemat biaya. Radius operasi ini merupakan fungsi dari jenis truk dan banyaknya limbah padat yang dikumpulkan. Pada umumnya, apabila waktu perjalanan ke tempat pembuangan sama dengan atau lebih lama dari setengah dari waktu pemuatan (atau pengumpulan) sehari, bentuk pemindahan sementara perlu dipertimbangkan. Walaupun pemindahan sementara memungkinkan penghematan, tindakan tersebut memerlukan langkah penanganan serta biaya tambahan. Oleh karena itu, sisi ekonomi dari pengembangan dan pengelolaan stasiun pemindahan harus dievaluasi secara cermat untuk membuktikan bahwa hal tersebut merupakan tindakan yang sangat hemat biaya untuk mengangkut limbah padat ke lokasi pembuangan.

Pemindahan mengacu kepada pemindahan limbah padat dari kendaraan pengumpul primer ke kendaraan pengangkut sekunder (yang biasanya lebih besar dan lebih efisien) melalui stasiun pemindahan atau bak-bak pengumpulan untuk diangkut ke tempat pembuangan. Manfaat dari stasiun pemindahan mencakup hal-hal berikut ini:

1. Peningkatan produktivitas petugas pengumpul.
2. Perpanjangan masa pakai kendaraan pengumpul.
3. Penghematan dalam hal modal dan bahan bakar kendaraan pengangkut, dan biaya perawatan.
4. Berkurangnya lalu lintas truk di jalan raya.
5. Berkurangnya emisi dan dampak lingkungan hidup.
6. Berkurangnya kerusakan terhadap jalan dan jalan raya perkotaan.
7. Peluang untuk menyeleksi limbah padat sebelum dibuang.
8. Peluang untuk mengalihkan limbah padat dan bahan-bahan lain untuk digunakan kembali atau didaur ulang.
9. Tempat-tempat yang nyaman untuk memudahkan pengelolaan C&D yang dihasilkan secara pribadi.
10. Fleksibilitas dalam mengakses fasilitas pengelolaan dan pembuangan limbah padat alternatif.

Gambar 18 – Truk Transfer dengan Trailer

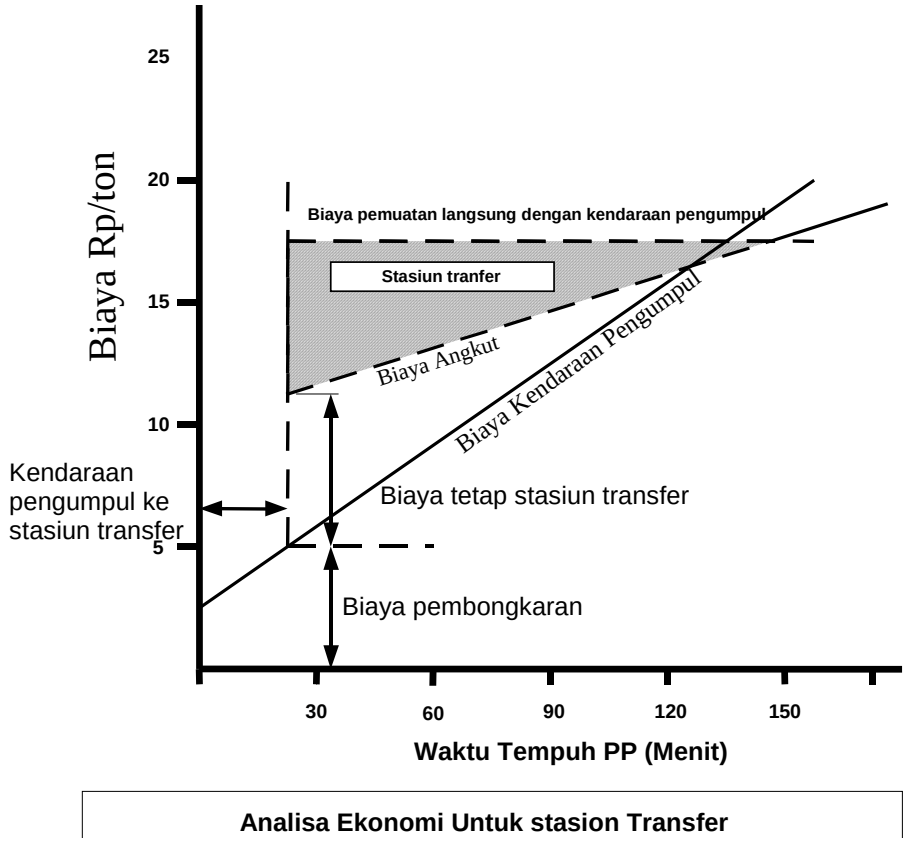
Meskipun semua sistem persampahan biasanya mencakup pengumpulan, sistem-sistem tersebut tidak mencakup stasiun-stasiun pemindahan yang tergantung pada kedekatan lokasi pembuangan terhadap titik atau rute pengumpulan. Lokasi stasiun pemindahan harus didasarkan pada faktor-faktor berikut ini:

1. Lingkungan tempat tinggal di mana stasiun pemindahan berlokasi harus bersedia menerima tempat pemindahan sebagaimana telah dirancang.
2. Bau, kebisingan dan peningkatan lalu lintas harus diminimalisir selama beroperasinya stasiun.
3. Stasiun tersebut harus cukup dekat dengan daerah pengumpulan sehingga kendaraan-kendaraan pengumpul langsung dapat kembali secara cepat ke rute-rute pengumpulan mereka.
4. Tempat tersebut harus memiliki akses yang mudah ke jalan-jalan utama.
5. Analisis atas waktu pengangkutan dari lokasi-lokasi pengumpulan dan rute-rute ke lokasi-lokasi pembuangan akan menentukan waktu yang dapat dihemat melalui penggunaan stasiun pemindahan.

Di banyak daerah yang luas dan berpenduduk padat atau di wilayah dengan konsentrasi penduduk yang tersebar, mungkin lebih dari satu stasiun pemindahan yang dibutuhkan. Jumlah

stasiun pemindahan yang cocok sangat tergantung pada jumlah dan ukuran dan wilayah layanan masing-masing serta jarak antara wilayah-wilayah tersebut. Sebuah stasiun pemindahan dapat mencakup pemadatan sampah untuk meningkatkan volume sampah yang dimasukkan ke dalam kendaraan pengangkut untuk pengangkutan yang efisien. Praktik ini lazim di negara-negara maju, namun mungkin belum cocok digunakan di negara-negara berkembang.

Terdapat sejumlah manfaat lingkungan dari pemindahan sampah. Stasiun pemindahan membantu mengurangi emisi udara dan konsumsi bahan bakar dan akses terhadap sampah pada stasiun pemindahan dapat membantu meningkatkan tingkat pengembalian. Keberadaan tempat pemindahan sampah juga memungkinkan lokasi pembuangan akhir menjadi tidak terlalu tergantung pada aksesibilitas oleh kendaraan-kendaraan pengumpul. Hal ini memungkinkan penentuan lokasi pembuangan dengan lebih banyak pertimbangan faktor kesehatan masyarakat dan lingkungan, sehingga tidak perlu berdekatan dengan penghasil sampah.



Gambar 19 – Contoh Analisa Ekonomi Stasiun Transfer

Dalam mengkaji penerapan pemindahan yang akan baik digunakan dalam penyediaan layanan yang menjadi tanggung jawab dari berbagai instansi di Manado, pertimbangan perlu diberikan terhadap perbedaan-perbedaan antara bak-bak pengumpul dan stasiun-stasiun pemindahan sebagai titik temu antara sistem pengumpulan primer dan sistem pengumpulan sekunder. Tabel berikut memperbandingkan sifat-sifat dari masing-masing pendekatan.

Rancangan Stasiun Pemindahan - Stasiun-stasiun pemindahan harus dirancang agar nyaman dan aman dengan tempat penyimpanan yang sesuai untuk sampah yang diterima dari rute-rute pengumpulan. Skema operasinya harus sesederhana mungkin dan mempersyaratkan

penanganan limbah padat yang minimal dan memberikan keluwesan dalam memodifikasi fasilitas tersebut apabila diperlukan. Berikut ini kriteria umum untuk rancangan stasiun pemindahan:

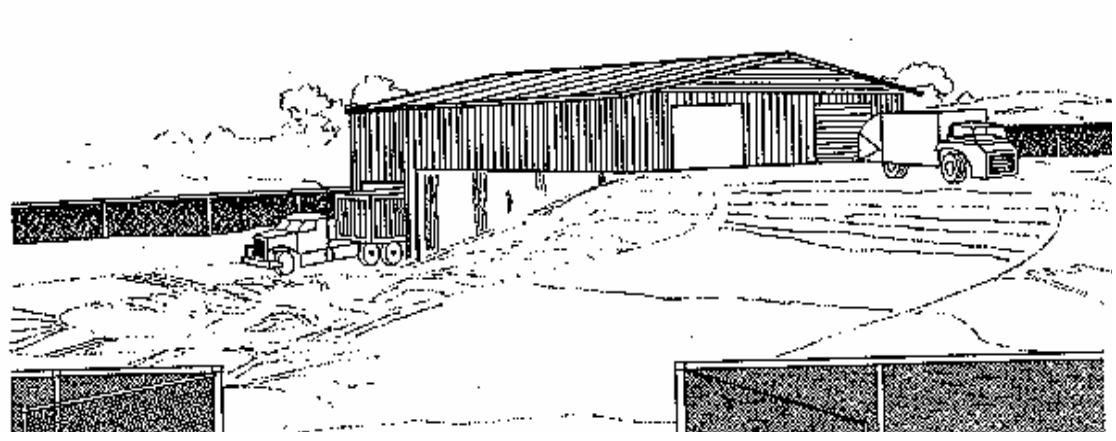
1. **Lokasi** - Lokasi stasiun pemindahan harus cukup besar untuk menampung bangunan, penyimpanan sampah, pergerakan kendaraan, dan kemungkinan perluasan. Sampai ke tingkat yang memungkinkan, lokasi harus memiliki perubahan ketinggian yang cukup untuk mengakomodasi jalur dua tingkat, rancangan bangunan atau tempat.
2. **Teknik Pemindahan** - Terdapat tiga jenis stasiun pemindahan yang lazim digunakan apabila kendaraan pengumpul membuang sampah 1) ke lantai penutupan, 2) ke lubang atau wadah penampung atau 3) langsung ke trailer pemindah. Apabila sampah ditumpahkan dari kendaraan-kendaraan ke lantai penutupan, peralatan tambahan seperti mesin pemuat diperlukan untuk mendorong sampah ke kendaraan pemindah atau ke dalam wadah penampung dari mesin pemadat eksternal. Kriteria dasar dari masing-masing jenis stasiun pemindah adalah sebagai berikut:

   Stasiun pemindahan dengan lantai penutup terbuka

   a. Biasanya lebih efisien untuk sampah yang jumlahnya sedikit
   b. Dapat digunakan untuk memindahkan berbagai macam material ke dalam kendaraan-kendaraan yang berbeda.
   c. Dapat dengan mudah mengakomodasi pengambilan kembali barang-barang yang memiliki nilai daur ulang
   d. Memungkinkan pengambilan sampah selama pemindahan
   e. Memperbesar kemungkinan penyebaran sampah sehingga kering sebelum pemindahan

   Stasiun pemindahan lubang terbuka

   a. Memungkinkan banyak kendaraan pengumpul untuk membongkar sampah pada saat bersamaan.
   b. Dapat menampung kendaraan-kendaraan pengumpul yang lebih besar.
   c. Biaya modal dan operasional yang lebih tinggi dibandingkan dengan konsep lantai penutup terbuka
   d. Pra-pengolahan dan pemisahan barang-barang yang dapat dipergunakan kembali sulit dilakukan.



Gambar 20 – Stasiun Transfer Bertingkat

   Stasiun pemindahan pembuangan langsung

   a. Tidak ada penanganan antara yang dapat meningkatkan efisiensi dan mengurangi tenaga kerja
   b. Tidak memungkinkan dilakukannya pengambilan sampah
   c. Membutuhkan bagunan dua lantai dengan trailer penerima pada lantai bawah

d. Dapat dibangun segera atau dipindahkan dan relatif tidak mahal
e. Memerlukan jumlah trailer yang cukup tergantung pada jumlah sampah yang diterima dan jarak terhadap lokasi-lokasi pengolahan atau pembuangan akhir.

Biasanya, stasiun-stasiun pemindahan kecil merupakan stasiun-stasiun pembuangan langsung yang tidak menyediakan daerah penyimpanan sampah sementara. Stasiun-stasiun ini biasanya memiliki daerah-daerah pembongkaran sampah yang dapat digunakan oleh masyarakat umum selain untuk pengoperasian yang utama yang ditujukan untuk truk pengumpulan limbah padat kota atau swasta. Tergantung pada lokasi, persyaratan estetika lokasi, dan pertimbangan lingkungan, operasi-operasi pemindahan dengan ukuran ini dapat ditempatkan baik di dalam atau luar ruangan. Sebagian besar stasiun pemindahan biasanya dijaga selama jam pengoperasian.

Gambar 21 – Stasiun Transfer

Stasiun-stasiun pemindahan yang lebih kecil yang digunakan di daerah pedesaan sering memiliki bentuk yang sederhana dan sering tidak diperhatikan. Stasiun-stasiun ini terdiri dari rangkaian bak tanpa penutup yang diisi oleh pengguna stasiun. Bak-bak ini kemudian dimuat ke dalam kendaraan yang lebih besar atau langsung diangkut ke tempat pembuangan dan dibongkar. Kapasitas stasiun keseluruhan yang dipersyaratkan (yaitu jumlah dan ukuran bak) tergantung pada besar dan kepadatan penduduk dari daerah yang dilayani dan frekuensi pengumpulan limbah padat. Untuk memudahkan pemuatan, dinding penahan yang sederhana akan memungkinkan bak untuk berada di lantai bawah sehingga bagian atas bak berada pada atau sedikit di atas permukaan tanah di daerah pemuatan.

Faktor-faktor yang harus dipertimbangkan dalam menentukan ukuran fasilitas pemindahan yang sesuai antara lain adalah sebagai berikut:

1. Kapasitas dari kendaraan-kendaraan pengumpul yang menggunakan fasilitas tersebut,
2. Jumlah hari yang diinginkan untuk ruang penyimpanan di lantai penutup,
3. Waktu yang dibutuhkan untuk memuat kendaraan-kendaraan pemungutan dari segala jenis yang digunakan dalam sistem pengumpulan,
4. Jumlah maksimal kendaraan yang akan menggunakan stasiun pada setiap waktu dan jam-jam kedatangannya,
5. Pemilahan atau pengolahan limbah padat yang akan dilakukan di fasilitas tersebut, apabila ada,
6. Kapasitas trailer pemindah (yang digunakan dan yang disiagakan),
7. Lama pengoperasian stasiun, dan

8. Waktu yang dibutuhkan bagi trailer pemuat dan pengangkut.

Prosedur-Prosedur Pembangunan Stasiun Pemindahan Sampah

Langkah 1: Penilaian atas Penerapan Stasiun Pemindahan Limbah padat– Tujuan dari langkah pertama ini adalah untuk menentukan apakah manfaat dari pemindahan limbah padat melebihi biayanya. Hal tersebut dapat ditentukan dengan melakukan analisis titik impas. Faktor-faktor yang diperhitungkan dalam analisis tersebut antara lain adalah sebagai berikut ini:

1. Lokasi stasiun pemindahan limbah padat dan tempat pengolahan/ pembuangan sampah.
2. Muatan rata-rata kendaraan pengumpul sampah dan kendaraan pemindah sampah.
3. Kecepatan dan jarak perjalanan kendaraan pengangkut.
4. Ukuran, teknologi, dan pengoperasian fasilitas pemindahan sampah.
5. Biaya pengoperasian kendaraan pengumpul dan pemindah sampah.

Untuk menghitung titik impas pemindahan sampah, pertama-tama tentukan terlebih dahulu nilai-nilai berikut ini:

1. Biaya Stasiun Pemindahan Sampah: biaya pembangunan, kepemilikan, dan pengoperasian stasiun pemindahan sampah, dalam Rp. per ton.
2. Muatan Pengangkutan Langsung: muatan rata-rata kendaraan pengumpul sampah yang mengangkut langsung ke lahan pembuangan akhir, dalam ton.
3. Muatan Pengangkutan Pindahan: muatan rata-rata truk pemindah sampah yang mengangkut dari stasiun pemindah sampah ke lahan pembuangan akhir, dalam ton.
4. Biaya Transportasi: biaya rata-rata pengangkutan langsung atau pemindahan, dalam Rp. per km.

Setelah nilai-nilai tersebut diketahui, hitung biaya untuk jarak pengangkutan yang berbeda ke tempat pembuangan. Perhitungan pertama adalah perhitungan biaya pengangkutan langsung tanpa melalui stasiun pemindah yang dihitung dengan menggunakan rumus berikut ini:

$$\frac{\text{Jarak (km) x Biaya Transportasi (Rp./km)}}{\text{Muatan Pengangkutan Langsung (ton)}}$$

Biaya perbandingan dengan digunakannya fasilitas pemindah sampah dapat dihitung dengan menggunakan rumus berikut:

$$\frac{\text{Biaya Stasiun Pemindahan Sampah (Rp./ton) + Jarak (km) x Biaya Transportasi (Rp./km)}}{\text{Muatan Pengangkutan Pindahan (ton)}}$$

Dalam melakukan analisis titik impas, dapat dibuat gambaran grafis tentang biaya-biaya. Contoh diagram tersebut dapat dilihat pada gambar berikut. Apabila jarak dari titik akhir semua rute pengumpulan sampah sampai ke fasilitas pengolahan/pembuangan **kurang** dari jarak impas yang diperhitungkan, maka pemindahan sampah tidak memberikan manfaat. Namun, apabila jarak dari titik akhir sebagian atau semua rute pengumpulan sampah **melebihi** jarak impas yang diperhitungkan, maka terdapat potensi manfaat.

Langkah 2: Buat Rancangan Konseptual – Apabila manfaat ekonomis yang nyata dapat ditentukan dengan melakukan analisis tersebut di atas, maka langkah selanjutnya harus diambil. Langkah tersebut mencakup pembuatan rancangan konseptual untuk menjawab pertanyaan-pertanyaan berikut:

1. Jenis limbah padat dan/ atau bahan daur ulang apakah yang dapat diterima oleh stasiun pemindahan sampah tersebut?
2. Berapakah volume rata-rata sampah yang dapat ditangani oleh stasiun pemindahan sampah tersebut?
3. Berapa banyak limbah padat yang akan diterima oleh fasilitas tersebut pada saat arus tertinggi?
4. Apakah stasiun pemindah sampah akan menerima limbah padat dari masyarakat umum atau membatasi akses kepada kendaraan pengumpul sampah milik pemerintah dan/ atau pihak swasta?
5. Fungsi tambahan apakah yang akan ada di stasiun pemindahan sampah (contoh, program pemanfaatan kembali, penanganan sampah khusus, dan perawatan kendaraan)?
6. Apakah ciri-ciri kendaraan pengumpul sampah yang akan menggunakan fasilitas tersebut?
7. Seberapa besar ruang penimbunan sampah yang diperlukan?
8. Teknologi pemindahan sampah apa yang akan digunakan?
9. Bagaimana limbah padat diangkut setelah pemindahan? Dengan truk atau kereta?
10. Siapa yang akan diizinkan untuk menggunakan fasilitas tersebut?
11. Bahan-Bahan apa yang akan diterima oleh fasilitas pemindahan sampah? Bahan yang umumnya diterima mencakup: limbah padat kota, sampah hijau, limbah rumah tangga yang berbahaya, bahan daur ulang, puing bangunan dan bongkaran.

Langkah 3: Tentukan Ukuran dan Kapasitas Stasiun Pemindahan Limbah padat – Terdapat sejumlah faktor yang mempengaruhi ukuran dan kapasitas stasiun pemindahan limbah padat, yaitu:

1. Penentuan wilayah pelayanan.
2. Jumlah limbah padat yang dihasilkan di wilayah pelayanan.
3. Jumlah dan jenis kendaraan yang mengangkut limbah padat.
4. Jenis bahan yang dipindahkan.
5. Ketersediaan truk gandeng pemindah sampah.
6. Perkiraan berat limbah padat dibanding masa operasi stasiun.
7. Hubungan dengan fasilitas yang sudah ada dan yang sedang diusulkan.

3.7. MENERAPKAN SISTEM PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

Sebagaimana yang terjadi pada sebagian besar perubahan sistem pengumpulan limbah padat, perubahan dalam penentuan rute atau frekuensi pengumpulan limbah padat mempengaruhi paling sedikit tiga kelompok masyarakat, yaitu: 1) mereka yang bertanggung jawab atas pengumpulan limbah padat dan program pemindahan sampah, 2) kru pengumpul sampah, dan 3) para penghasil sampah. Program penyuluhan dan pendidikan harus menginformasikan secara memadai tentang apa yang diharapkan dari setiap kelompok-kelompok tersebut dan bekerja sama dengan mereka dalam mewujudkan perubahan yang diharapkan serta dalam pelaksanaan proses pengumpulan sampah yang telah direvisi atau dikembangkan.

Pengumpul limbah padat dan pengemudi harus diberitahu tentang perubahan yang diusulkan atas sistem pengumpulan limbah padat dan mendorong mereka untuk memberikan komentar tentang pengaruhnya terhadap operasi harian yang akan mereka jalani. Kritik atau saran dari mereka untuk pengembangan lebih lanjut sangat penting bagi evaluasi akhir yang dilaksanakan oleh para pengelola limbah padat. Selain sebagai sumber potensial untuk mendapatkan

masukan yang terkait, partisipasi para pekerja dalam meninjau kembali keputusan yang telah diambil dapat menjadi perangkat pengelolaan yang berguna karena membantu mereka merasakan sebagian dari sistem yang baru dan lebih mendukung perubahan yang mungkin diperlukan. Mekanisme komunikasi yang menghasilkan kerja sama dari personel pengumpul sampah dapat membantu mengembangkan atau memelihara moril pekerja selama dan setelah pelaksanaan.

Gambar 22 – Stasiun Transfer Outdoor Bertingkat dengan Truk Penderek

Pejabat publik lainnya (khususnya pejabat yang dipilih rakyat) juga harus diberitahu tentang perubahan yang diusulkan seiring dengan diterapkannya sistem pemindahan sampah yang baru atau dengan adanya perubahan besar pada pendekatan sistem pengumpulan sampah. Apabila alasan perubahan dalam sistem pengumpulan sampah tersebut dijelaskan kepada mereka, seringkali mereka dapat menjadi mitra yang penting selama masa transisi. Apabila mereka dihubungi oleh para penghasil sampah tentang perubahan-perubahan tersebut, mereka harus mengetahui apa yang sedang terjadi sehingga dapat memberikan jawaban yang tepat atas pertanyaan yang diajukan oleh rakyat yang memilih mereka.

Penerapan aspek teknis dari pendekatan pengumpulan/ pemindahan sampah yang baru perlu dilaksanakan secara bertahap seiring dengan berkembangnya kebutuhan akan pemindahan sampah akibat pembangunan lahan pembuangan akhir yang baru dan penutupan tempat pembuangan tidak terkendali. Oleh karena itu, para pengelola limbah padat perlu merencanakan perubahan sistem berdasarkan setiap wilayah pelayanan. Sebuah rencana menyeluruh perlu dibuat untuk menentukan perubahan teknis yang harus dibuat dan jadwal penyediaan sumber daya yang diperlukan serta melaksanakan rencana tersebut.

4. MENGOPERASIKAN DAN MEMELIHARA SISTEM PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

4.1. MENGELOLA OPERASI DAN PEMELIHARAAN SISTEM PENGUMPULAN LIMBAH PADAT

Sistem pengumpulan limbah padat yang efektif memerlukan adanya pengaturan yang mantap dan menyeluruh serta pengendalian operasi yang berkesinambungan. Pengaturan dan pengendalian tersebut harus mencakup koordinasi yang baik antara tingkat-tingkat administrasi pemerintah daerah untuk menjamin bahwa program yang menjadi tanggung jawab mereka masing-masing berjalan tanpa adanya masalah.

Dari sudut pandang pengelolaan setiap komponen, pengaturan dan pengendalian yang efektif mengharuskan agar semua personel yang terlibat dalam proses pengumpulan limbah padat untuk bertanggung jawab atas kinerja mereka. Untuk mencapai hal tersebut, paling tidak pengaturan perlu mencakup pencatatan, pengawasan langsung terhadap pelaksanaan sistem melalui pemeriksaan dan pengamatan, pengawasan pemeliharaan, penyiapan peralatan cadangan, dan akuntansi biaya yang efektif.

Pencatatan sangat berperan penting dalam pengawasan dan dokumentasi pelaksanaan serta efektivitas program pengumpulan limbah padat. Adalah mustahil untuk mencapai tingkat yang diperlukan untuk menjaga pelayanan yang baik dan berkesinambungan tanpa adanya pencatatan yang baik, pengukuran produktivitas, evaluasi, studi biaya, dan pemeliharaan preventif. Catatan yang harus secara rutin dibuat oleh pengelola atau pejabat publik mencakup:

1. Peta rute
2. Catatan tentang kendaraan, termasuk data pembelian, catatan perawatan dan perbaikan, catatan konsumsi bahan bakar, catatan kecelakaan, waktu operasi, waktu perjalanan rute, waktu menuju dan kembali dari tempat pembuangan
3. Catatan kru, termasuk limbah padat yang dikumpulkan per hari, sampah rumah tangga yang dikumpulkan per hari, sampah yang dikumpulkan dari tempat pemberhentian kendaraan pengumpul limbah padat lainnya per hari, pemindahan dengan truk, waktu perjalanan rute, waktu perjalanan di luar rute
4. Catatan muatan, termasuk berat, jumlah ritasi ke tempat pembuangan per hari, persentase kapasitas penuh per hari, dsb.

Catatan-catatan tersebut penting dalam memantau pelaksanaan program pengumpulan limbah padat. Catatan-catatan tersebut juga berfungsi sebagai dasar perencanaan dan perancangan pengembangan pelayanan serta fasilitas-fasilitas baru seperti stasiun pemindahan sampah dan tempat pembuangan akhir.

4.2. MELATIH PERSONIL

Semua personil pengumpul limbah padat perlu dilatih dalam melaksanakan tanggung jawabnya. Dalam pelatihan tersebut, perlu ditentukan tingkat produktifitas yang diharapkan dari mereka. Paling tidak, pelatihan harus diberikan berkaitan hal-hal berikut ini:

1. Struktur rute dan produktifitas pengumpulan sampah yang diharapkan.
2. Pencatatan
3. Kesehatan dan keamanan
4. Prosedur-prosedur darurat
5. Pengoperasian dan pemeliharaan peralatan pengumpul sampah
6. Pengoperasian dan pemeliharaan stasiun pemindah sampah

Selain pelatihan dasar tersebut di atas, pelatihan khusus perlu diberikan kepada para pengelola program yang akan bertanggung jawab atas pengawasan dan pemeriksaan terhadap pelaksanaan sistem. Pelatihan tersebut juga perlu mencakup pelatihan tentang unsur-unsur perancangan seperti analisis penentuan rute untuk memungkinkan adanya pengawasan yang berkesinambungan terhadap pelaksanaan dan identifikasi kebutuhan sistem. Pelatihan juga perlu diberikan untuk personil yang bertanggung jawab atas pemeliharaan semua peralatan pengumpul sampah untuk memastikan dilaksanakannya pemeliharaan preventif yang memadai untuk menjamin ketersediaan dan masa pakai peralatan yang maksimal.

4.3. MENDIDIK PARA PENGHASIL LIMBAH PADAT TENTANG PERAN MEREKA DALAM PENGUMPULAN LIMBAH PADAT YANG EFEKTIF

Untuk menjaga efektifitas program, program penyuluhan dan pendidikan masyarakat perlu diselenggarakan yang ditujukan untuk para penghasil sampah. Beberapa cara dapat diterapkan untuk mencapai hal tersebut. Salah satu cara terbaik adalah surat dari pejabat publik yang berwenang yang menjelaskan tentang alasan dari setiap perubahan atas metodologi dan jadwal pengumpulan sampah serta bagaimana perubahan tersebut dapat mempengaruhi para penghasil sampah. Cara lain yang efektif dalam menyampaikan informasi kepada masyarakat adalah melalui artikel-artikel dan pemberitahuan yang dicetak dalam surat kabar setempat. Tergantung pada wilayah pelayanan masing-masing dalam sistem pengumpulan sampah utama, organisasi masyarakat dan LSM dapat memberikan dukungan untuk mendidik masyarakat tentang peran mereka yang baru dalam program pengumpulan sampah.

4.4. MEMBUAT PROSEDUR-PROSEDUR DARURAT UNTUK KEADAAN KHUSUS

Pengumpulan dan pemindahan sampah yang efektif memerlukan adanya pembuatan prosedur-prosedur darurat untuk setiap keadaan keadaan khusus. Paling tidak prosedur-prosedur darurat harus dibuat untuk hal-hal berikut ini:

Kecelakaan – Mengingat sifat kendaraan bermotor dan proses pengumpulan limbah padat, kecelakaan dapat terjadi. Kecelakaan tersebut dapat saja hanya melibatkan kendaraan dan personel sistem pengumpul sampah tetapi dapat juga melibatkan pihak lainnya. Setiap kecelakaan yang terjadi harus segera dilaporkan dan diselidiki untuk menentukan tingkat dan penyebab kecelakaan tersebut. Prosedur-prosedur darurat yang berkaitan dengan kecelakaan

harus berupa sebuah fungsi tentang tingkat keparahan dari kecelakaan tersebut. Semua personil perlu diberi pelatihan tentang setiap prosedur darurat yang digunakan pada saat terjadi kecelakaan. Kru pengumpul sampah perlu secara khusus diberi pelatihan tentang prosedur-prosedur yang digunakan pada saat terjadi kecelakaan yang menyebabkan seseorang menderita luka serius. Dalam keadaan yang mengancam keselamatan seseorang, personil tersebut harus siap untuk mengambil tindakan yang diperlukan termasuk pertolongan pertama dalam keadaan darurat dan segera memberitahu sumber pertolongan darurat lainnya.

Keluhan – Keluhan yang terkait dengan sistem pengumpulan limbah padat mungkin saja diterima. Semua keluhan harus dicatat dan diselidiki. Sama halnya dengan prosedur yang digunakan untuk menangani kecelakaan, keluhan harus dievaluasi untuk menentukan penyebabnya dan untuk mengatasi penyebab keluhan tersebut. Penyesuaian terhadap sistem pengumpulan limbah padat mungkin diperlukan untuk menghilangkan penyebab keluhan yang dapat diterima, khususnya yang terjadi berulang kali. Sebagai prosedur darurat, pengelola limbah padat perlu bersiap-siap untuk menangani masalah-masalah seperti berlebihnya bak sampah atau akumulasi sampah di wilayah-wilayah yang tidak direncanakan. Penanganan keluhan tepat pada waktunya sangat penting karena sedikit saja akumulasi sampah di tempat yang tidak terkendali dapat memerlukan kegiatan yang besar untuk membersihkannya apabila tetap dibiarkan dan menjadi semakin menumpuk.

4.5. MENGEMBANGKAN DAN MENGELOLA PROGRAM PEMELIHARAAN YANG EFEKTIF

Pengoperasian yang berhasil dan produktifitas dari setiap sistem pengumpulan dan pemindahan sampah bergantung pada cara pemeliharaan berbagai peralatan yang digunakan dalam program. Selain pemeliharaan yang memadai, peralatan cadangan yang cukup harus tersedia untuk memastikan bahwa setiap siklus pengumpulan sampah dapat diselesaikan dengan jadwal servis yang tidak berubah-ubah. Penentuan rute, pengoperasian, pemeliharaan preventif dan perbaikan yang efektif dapat memberi kontribusi dalam meningkatkan produktifitas kendaraan dalam jangka panjang.

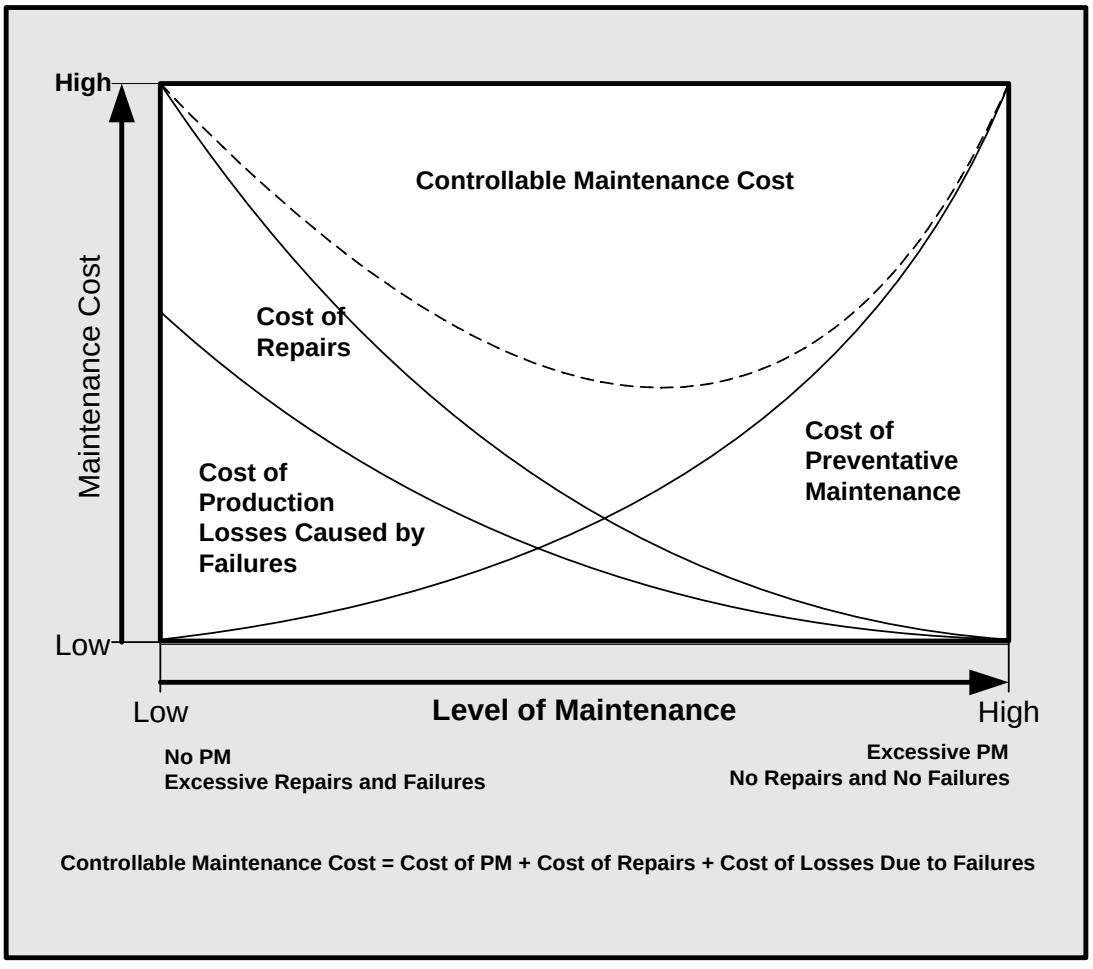
Jenis-jenis Pemeliharaan – Ada dua jenis pemeliharaan yang perlu dilakukan setiap harinya, yaitu perbaikan dan pencegahan kerusakan. Pengalaman menunjukkan bahwa setiap kali peralatan mekanik digunakan, terdapat hubungan langsung antara tingkat pencegahan kerusakan dengan tingkat perbaikan kerusakan yang diperlukan. Secara logika, terdapat tindakan pencegahan kerusakan apabila penghematan biaya program pemeliharaan tidak tercapai. Tingkat pencegahan kerusakan yang sangat tinggi secara teori dapat menurunkan tingkat kerusakan pada peralatan. Namun demikian, biaya pada tingkat ideal ini sangat besar. Demikian juga biaya perbaikan kerusakan dapat sangat besar, apabila pencegahan kerusakan tidak dilakukan,. Rancangan program pemeliharaan yang efektif berusaha menciptakan keseimbangan optimal antara perbaikan dan pencegahan kerusakan yang bersifat paling hemat biaya.

Pemeliharaan Perbaikan Kerusakan – Perbaikan kerusakan mencakup perbaikan apabila diperlukan karena rusaknya peralatan. Karena kerusakan tidak dapat direncanakan, kerugian yang ditimbulkan oleh beberapa peralatan karena jangka waktu tidak beroperasi selama perbaikan harus ditambahkan pada biaya perbaikan keseluruhan untuk menentukan dampak ekonomi dari kerusakan tersebut secara keseluruhan. Selain itu, peralatan cadangan diperlukan sehingga tingkat layanan tidak terpengaruh oleh kerusakan peralatan. Di beberapa kota di mana terdapat kekuarangan peralatan, para pengelola limbah padat menghentikan

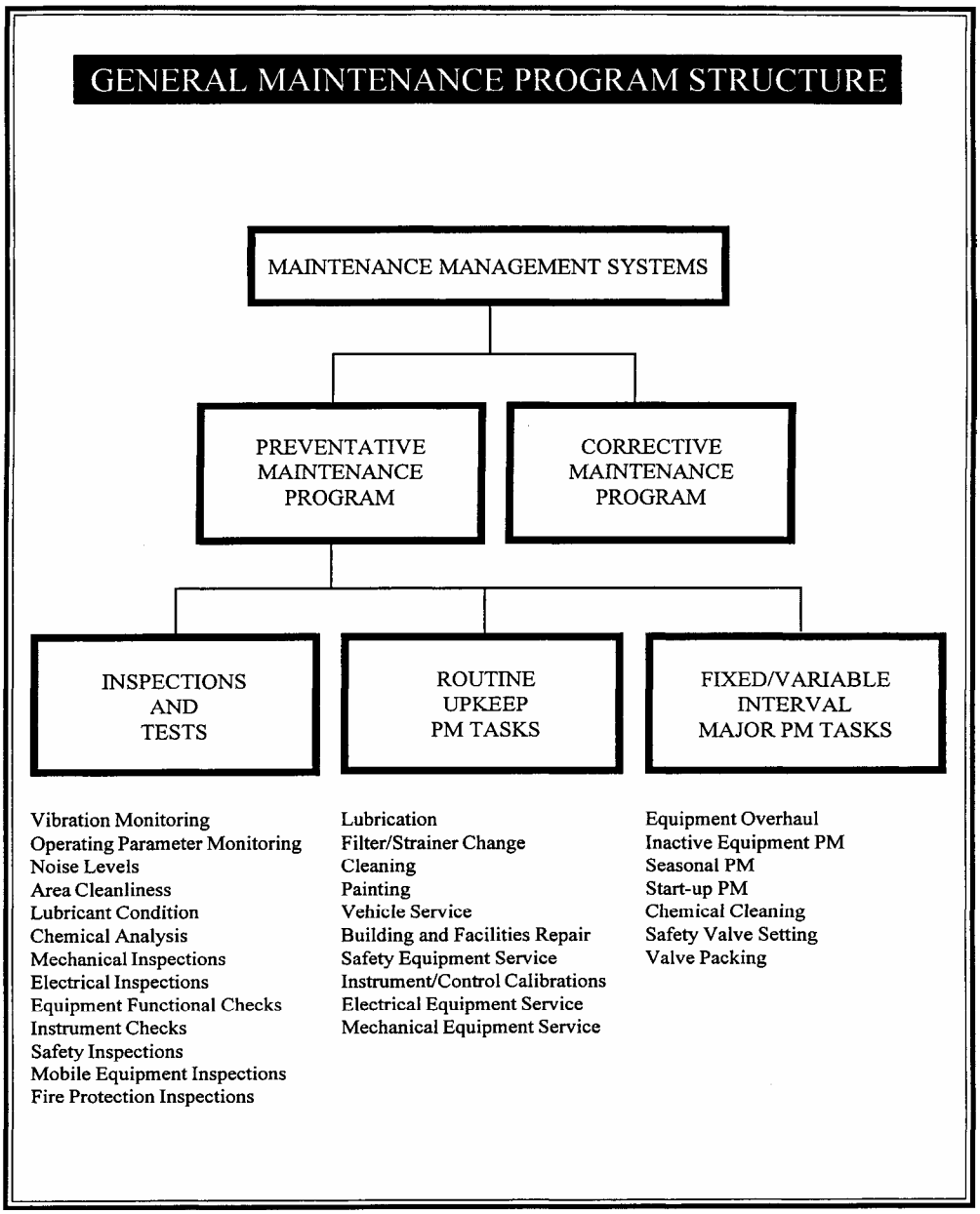
pengumpulan sampah apabila peralatan rusak. Hal ini secara langsung mempengaruhi persepsi dari program pengumpulan limbah padat.

Pemeliharaan Pencegahan Kerusakan – Menurut definisinya, pemeliharaan pencegahan kerusakan terdiri dari:

1. Pemeriksaan berjangka terhadap peralatan untuk mengetahui kondisi yang pada akhirnya dapat menimbulkan kerusakan atau penyusutan yang merugikan.
2. Pencegahan kesulitan-kesulitan yang mungkin timbul dengan melakukan perbaikan-perbaikan kecil sebelum muncul masalah-masalah besar.
3. Penggantian, penyesuaian, perbaikan dan pemeriksaan yang telah dijadwalkan dan direncanakan sebelumnya dalam siklus yang akan membuat peralatan tetap pada tingkat efisiensi operasi yang optimal.
4. Kebijakan untuk mengoperasikan peralatan secara tepat dan dalam jangkauan kemampuan rancangannya.



Gambar 23 – Model Ekonomi Pemeliharaan Preventif



Gambar 24 – Struktur Program Pemeliharaan Umum

Rancangan program pemeliharaan yang efektif lazimnya mencakup bahwa baik pemeliharaan pencegahan maupun perbaikan kerusakan merupakan bagian dari prosedur operasi reguler. Meskipun demikian, penekanan rencana pemeliharaan harus diberikan pada program pencegahan kerusakan yang meminimalkan tingkat perbaikan yang diperlukan. Kegiatan pencegahan kerusakan biasanya dijadwalkan dan direncanakan sebelumnya, sehingga memudahkan pemrograman pekerjaan pemeliharaan. Hal ini secara signifikan meningkatkan perencanaan dan penjadwalan seluruh kegiatan pengelolaan pemeliharaan. Pengalaman yang diperoleh selagi peralatan pengumpul sampah dioperasikan membantu mengidentifikasi peralatan dalam kondisi "kritis" yang harus diutamakan dalam program pemeliharaan.

Program pencegahan kerusakan yang efektif terbagi menjadi tiga kategori yang mencakup: 1) pengawasan, pemeriksaan dan pengujian, 2) tugas-tugas pemeliharaan rutin dan 3) tugas-tugas penting dengan selang waktu tetap dan tidak tetap. Ketiga kategori di atas dijelaskan sebagai

berikut:

1. **Pengawasan, Pemeriksaan dan Pengujian** – Pemeriksaan peralatan dalam kondisi kritis merupakan bagian penting dari setiap program Pencegahan Kerusakan. Tujuan dari pemeriksaan adalah untuk mengidentifikasi dan memperbaiki kondisi-kondisi yang tidak diinginkan yang dapat memburuk. Hal ini dapat membantu mencegah kerusakan. Kegiatan-kegiatan pemeriksaan dapat berhasil melalui berbagai cara seperti pemeriksaan visual, pengawasan parameter-parameter yang beroperasi normal, pengukuran dan analisis data, serta pengujian-pengujian khusus.
2. **Pemeliharaan dengan Jangka Waktu Tetap dan Tidak Tetap** – Pemeliharaan berjangka yang dilaksanakan secara rutin meningkatkan ketahanan dan memperpanjang masa pakai peralatan melalui pemeliharaan kondisi optimal peralatan. Tugas-tugas pemeliharaan rutin terhadap sebuah peralatan tertentu pada umumnya membutuhkan waktu penyelesaian yang singkat dan biasanya dilaksanakan berdasarkan jadwal reguler. Tugas-tugas pemeliharaan atas peralatan bermotor lazimnya terdiri dari kegiatan-kegiatan sebagai berikut: 1) pemberian minyak pelumas, 2) penggantian/ pembersihan filter/ saringan, 3) pembersihan dan pengecatan dan 4) servis kendaraan.
3. **Kegiatan Utama Pencegahan Kerusakan dan Perbaikan Besar** – Kategori terakhir dari kegiatan-kegiatan tersebut adalah kegiatan utama pencegahan kerusakan yang tetap dan yang tidak tetap. Peralatan bergerak yang penting secara rutin tidak dioperasikan untuk beberapa waktu untuk kepentingan pemeriksaan dan perbaikan besar. Frekuensi dan durasi waktu untuk pemeriksaan besar tersebut bervariasi tergantung pada peralatannya.

Untuk mendapatkan akuntabilitas pengawasan dan pengelolaan yang diperlukan dalam program pencegahan kerusakan yang baik, daftar serta catatan pelaksanaan tugas harus digunakan sebagai basis data dari seluruh pekerjaan yang dilakukan. Para staf pemeliharaan dan para operator peralatan diharapkan untuk mengisi daftar tugas-tugas yang mereka lakukan.

Salah satu permasalahan kritis di Manado di mana proses pengumpulan sampah telah terdesentralisasi dan peralatan telah disediakan oleh kota bagi kecamatan untuk pengumpulan sekunder adalah koordinasi antara fungsi-fungsi perbaikan dan pemeliharaan. Apabila pemeliharaan dan perbaikan diberikan oleh kota, hal ini harus dikoordinasikan secara ketat dengan jadwal pengumpulan oleh kecamatan. Selain itu, sistem dapat mengalami kegagalan apabila tidak tersedia cukup peralatan untuk pelayanan cadangan apabila peralatan tidak dioperasikan untuk kepentingan perbaikan atau pemeliharaan.

Peralatan Cadangan – Pengumpulan limbah padat merupakan proses yang sulit dan peralatan yang digunakan di dalam sistem pengumpulan limbah padat akan seringkali mengalami kerusakan. Untuk mempertahankan tingkat pelayanan yang baik, peralatan cadangan diperlukan sehingga pengumpulan sampah dapat terus berjalan bahkan pada saat peralatan utama mengalami kerusakan, dengan gangguan minimal terhadap pola dan jadwal pengumpulan sampah. Di negara-negara maju, peralatan cadangan ditargetkan di mana tersedia setidaknya satu buah kendaraan cadangan untuk setiap lima buah kendaraan yang digunakan setiap harinya.

4.6. PANTAU KERJA SISTEM DAN BUAT PENYESUAIAN TERHADAP SISTEM PENGUMPULAN LIMBAH PADAT SEBAGAIMANA DIPERLUKAN

Pengurangan biaya pengumpulan limbah padat dengan meningkatkan efisiensi pengumpulan limbah padat harus diawali dengan pemahaman penuh tentang kegiatan-kegiatan yang dilakukan selama hari pengumpulan sampah. Hari pengumpulan sampah dapat dibagi menjadi dua kategori besar untuk kepentingan pengawasan dan analisis:

1. Waktu yang dihabiskan untuk kegiatan-kegiatan yang tidak produktif ketika kru pengumpulan sampah tidak sibuk mengumpulkan sampah dari rute-rute pengumpulan limbah padat atau bak-bak sampah bersama.
2. Waktu yang benar-benar dihabiskan untuk mengumpulkan sampah sepanjang rute-rute pengumpulan sampah atau di lokasi-lokasi pelayanan bak sampah bersama.

Pengalokasian hari kerja untuk seluruh kegiatan yang produktif dan tidak produktif dapat ditetapkan dengan mencatat lamanya waktu yang dihabiskan petugas untuk setiap kegiatan dari saat mereka mulai bekerja di pagi hari sampai saat mereka berhenti bekerja di akhir hari kerja. Untuk contoh yang berkaitan dengan pengumpulan sampah dari tepi jalan, kegiatan-kegiatan utama pada hari pengumpulan sampah dapat dibagi kembali menjadi:

1. Waktu di pangkalan truk pada awal dan akhir hari kerja
2. Waktu perjalanan menuju ke rute pengumpulan sampah pada awal hari kerja dan kembali ke stasiun truk di akhir hari kerja
3. Waktu pembongkaran muatan kendaraan di fasilitas pemindahan, pengolahan atau pembuangan termasuk perjalanan ke dan dari fasilitas tersebut.
4. Waktu perjalanan saat melakukan kegiatan pengumpulan sampah

Bidang-bidang yang tidak produktif berikut ini layak mendapat perhatian khusus dalam pengawasan pelaksanaan sistem pengumpulan sampah:

1. Rute-rute pengumpulan limbah padat sebaiknya ditentukan sebelum hari pengumpulan sehingga setiap kru mengetahui ke mana mereka akan pergi pada hari yang bersangkutan. Rencana cadangan untuk hari-hari ketika terdapat kru yang sakit atau tidak hadir dengan alasan lain juga harus direncanakan sebelumnya.
2. Apabila mungkin, masing-masing truk sebaiknya diserahkan kepada seorang pengemudi untuk beberapa waktu, sehingga waktu tidak akan terbuang untuk mengubah posisi kaca spion, mengeluarkan barang-barang pribadi dari truk dan memeriksa ulang oli mesin dan peralatan. Perlu dicatat bahwa hal ini juga memudahkan penyelidikan terhadap kebiasaan mengemudi untuk menyerahkan tanggung jawab serta menilai tinggi rendahnya pemeliharaan setiap kendaraan.
3. Pemeliharaan rutin sebaiknya dilakukan pada akhir hari pengumpulan limbah padat dan lebih baik dilakukan oleh kru pemeliharaan dan bukan oleh pengemudi.
4. Jumlah ritasi luar rute untuk mengosongkan truk yang penuh sebaiknya dikurangi dengan memperbesar ukuran truk atau meningkatkan pemadatan materi dan dapat dipadatkan.
5. Titik-titik antrian untuk melakukan penimbangan dan pembongkaran muatan yang terdapat di fasilitas pembuangan atau pengolahan limbah padat harus dihilangkan baik dengan merancang ulang wilayah-wilayah tersebut atau menggilir jadwal pengiriman sampah oleh truk-truk.

6. Rute-rute antara lokasi stasiun truk dengan titik pengiriman sampah pada rute-rute pengumpulan sampah harus dievaluasi untuk mengurangi jarak perjalanan luar rute dan memastikan bahwa, untuk kepentingan praktis truk, rute-rute tersebut berada di sekitar wilayah dengan kondisi pergerakan lalu lintas pelan.

Dengan melakukan pemantauan secara teratur terhadap waktu yang dihabiskan untuk berbagai kegiatan, program pengumpulan sampah dapat terawasi untuk mempertahankan produktivitas. Setelah beberapa waktu, tingkat produktivitas akan nampak jelas bagi para pengelola limbah padat sehingga dapat diawasi. Apabila sistem ini dirancang dengan tepat dan tersedia cukup sumber daya, adanya kegagalan sistem (penumpukan sampah di luar bak-bak sampah, pelayanan yang tidak teratur, keluhan-keluhan, dll.) merupakan indikasi penurunan produktivitas yang dengan demikian menuntut penyelidikan lebih jauh terhadap produktivitas sistem dan pengelolaan aset. Hal ini kemudian dapat mendorong dilakukannya pelatihan dan pendidikan ulang untuk menekankan kembali kinerja yang diharapkan atau penyesuaian guna menyelesaikan permasalahan yang berkembang.

5. MASALAH-MASALAH UTAMA STRATEGI PENGOLAHAN LIMBAH PADAT

Terdapat beberapa masalah utama yang dapat mempengaruhi perubahan atau perbaikan cara pengumpulan limbah padat, sebagaimana dijelaskan di bawah ini:

5.1. PERAN SERTA SEKTOR SWASTA

Di masa yang akan datang, peranan sektor swasta dalam pengelolaan limbah padat di Indonesia dapat terlihat lebih nyata. Di banyak negara, perusahaan-perusahaan swasta telah berhasil mencapai kapitalisasi dan efisiensi operasi yang diharapkan yang telah membantu banyak kota untuk berhemat dengan mencapai hasil pengelolaan limbah padat yang lebih baik. Namun demikian, pengalaman dengan peran serta sektor swasta sangat jarang dijumpai di Indonesia.

Kontraktor swasta dapat menyediakan sarana yang berteknologi lebih modern dalam melakukan pengumpulan, pengolahan atau pembuangan sampah. Namun demikian, meminta pihak swasta untuk menggunakan peralatan baru yang dapat meningkatkan efektifitas dan efisiensi pengelolaan limbah padat membutuhkan pemahaman bahwa peralatan baru dan peningkatan pelayanan ini dapat meningkatkan biaya yang ditanggung oleh kota dan para penduduknya.

Peran sektor swasta juga memungkinkan penetapan standar-standar pelaksanaan yang harus dipatuhi oleh kontraktor tersebut. Standar-standar pelaksanaan dapat dijelaskan di dalam kontrak kerja yang akan ditanda tangani. Misalnya, apabila BPK bekerja sama dengan pihak swasta untuk melaksanakan pelayanan pengumpulan sampah dari bak-bak sampah, BPK dapat meminta tingkat pelayanan minimal sebagai syarat kontrak. Hal ini akan memungkinkan BPK untuk mengawasi kinerja pihak swasta tersebut dalam memberikan pelayanan yang baik. Di banyak tempat di mana kontrak-kontrak dengan sektor swasta telah dibuat, sanksi seringkali ditetapkan dalam kontrak terhadap kinerja yang buruk. Hal ini merupakan dorongan untuk mempertahankan tingkat pelayanan yang diharapkan.

Saat ini terdapat peranan yang muncul bagi perusahaan-perusahaan mikro di Manado untuk menyediakan pelayanan pengumpulan limbah padat dari rumah ke rumah di setiap kelurahan. Salah satu masalah yang perlu dievaluasi adalah bagaimana para kontraktor perusahaan mikro tersebut akan dibayar. Ada dua alternatif dasar yang dapat dipertimbangkan. Alternatif yang pertama, kontraktor dibayar secara langsung oleh penghasil sampah rumah tangga atau perusahaan atas pelayanan pengumpulan limbah padat dan pengangkutannya ke TPS setiap harinya. Alternatif yang kedua, kelurahan membayar pihak swasta untuk melaksanakan pelayanan pengumpulan limbah padat dari rumah ke rumah sebagaimana yang diharapkan. Sebaliknya, kelurahan akan berusaha mengumpulkan iuran dari para penghasil limbah padat untuk pelayanan yang disponsori pemerintah tersebut.

5.2. KESADARAN, KERJASAMA DAN PERANSERTA MASYARAKAT

Kesadaran masyarakat yang kuat tentang masalah pengelolaan limbah padat akan menjadi hal yang sangat penting apabila masalah limbah padat di Manado saat ini ingin diperbaiki. Sikap masyarakat terhadap limbah padat dan pembuangan sampah yang tidak pada tempatnya harus diubah agar tidak menimbulkan tambahan beban pada program pengumpulan sampah. Program kesadaran masyarakat perlu menciptakan hubungan yang jelas antara peranan yang dimiliki tiap-tiap penghasil sampah rumah tangga dalam efisiensi sistem pengumpulan sampah dan keberhasilannya secara keseluruhan. Program tersebut juga perlu menciptakan sarana yang dapat membuat para penghasil sampah merasa bahwa mereka "berperan" dalam solusi-solusi yang diterapkan. Hal ini mensyaratkan dikembangkannya sarana untuk mengumpulkan masukan dari masyarakat ke dalam proses perencanaan pengelolaan limbah padat.

Salah satu aspek penting dalam mencapai keadaan di mana masyarakat dapat menerima setiap pendekatan baru terhadap pengumpulan sampah adalah memastikan bahwa sistem yang diajukan memenuhi kebutuhan masyarakat. Di wilayah-wilayah dengan penghasilan rendah, pengelolaan limbah padat mungkin bukan prioritas tertinggi. Misalnya, survey yang dilakukan di Yogyakarta, menunjukkan bahwa pengeluaran seperti biaya untuk makanan (dapat mencapai 50% sampai 80% dari pendapatan), rumah, pakaian, listrik dan pendidikan dipandang sebagai prioritas yang lebih tinggi daripada pengelolaan limbah padat. Hal ini seringkali menempatkan pandangan para anggota masyarakat pada fokus yang berbeda dari pandangan para pengambil keputusan yang lebih terfokus pada masalah keamanan lingkungan dan kesehatan masyarakat. Walaupun penting untuk memastikan bahwa para penghasil limbah padat rumah tangga sadar akan aspek-aspek negatif dari pengelolaan limbah padat yang salah, sangat penting pula bagi sistem pengumpulan sampah yang baru atau yang ditingkatkan untuk memenuhi kebutuhan mereka yang mungkin lebih berorientasi pada kenyamanan dan keindahan.

Penting juga untuk menyadari bahwa pengelolaan pengumpulan limbah padat membutuhkan partisipasi yang signifikan dari para penghasil sampah rumah tangga yang mungkin terlibat dalam penyimpanan sampah di rumah-rumah, pemindahan sampah ke tepi jalan atau bak-bak sampah, dan pembayaran iuran. Oleh karena itu, kapasitas dan kesediaan masyarakat rumah tangga untuk memberikan kontribusi kepada pelayanan sangatlah penting. Dengan demikian, hal ini menciptakan prioritas bagi solusi-solusi biaya rendah daripada solusi-solusi teknologi tinggi yang mungkin lazim di negara-negara yang lebih maju.

Program kesadaran masyarakat juga seharusnya berusaha menciptakan hubungan yang jelas antara biaya sebenarnya dari pelayanan pengumpulan sampah pada tingkat yang wajar dan kesediaan penghasil sampah untuk melakukan pembayaran. Di seluruh dunia, pengalaman menunjukkan bahwa masyarakat bersedia membayar lebih untuk tingkat pelayanan yang lebih baik. Namun demikian, di beberapa lokasi, iuran meningkat tanpa adanya peningkatan yang signifikan dalam pelayanannya. Hal ini kemudian menjadi hambatan untuk menetapkan kenaikan iuran yang diperlukan untuk meningkatkan pelayanan.
Ada berbagai bentuk peran serta masyarakat antara lain:

1. Peran serta perorangan
2. Peran serta bersama
3. Kontribusi material dan keuangan
4. Peran serta aktif dalam penyusunan program.

Setiap bentuk partisipasi di atas harus merupakan bagian dari program pengelolaan limbah padat kota.

5.3. PEMULIHAN BIAYA DAN SUMBER DAYA KEUANGAN

Sampai pada tingkat yang memungkinkan, seharusnya terdapat hubungan yang jelas antara biaya pelayanan pengumpulan sampah yang sebenarnya dengan iuran dari para penghasil sampah yang harus membayar untuk pelayanan tersebut. Kondisi yang ideal adalah apabila pendapatan yang diberikan untuk pelayanan pengumpulan sampah jumlahnya sama dengan biaya keseluruhan untuk program tersebut. Para penghasil limbah rumah tangga harus mengetahui bahwa terdapat komponen yang berbeda-beda pada pelayanan pengumpulan limbah padat yang mereka terima. Misalnya, pembayaran langsung untuk pengumpulan sampah dari rumah ke rumah semata-mata untuk pelayanan itu saja, sedangkan biaya pengumpulan limbah padat yang sebenarnya ditanggung oleh kecamatan dan biaya pengoperasian TPA oleh BPK juga harus didanai seperti dengan cara penarikan retribusi yang ditagih bersamaan dengan tagihan listrik/air.

Mekanisme-mekanisme pemulihan biaya yang sering digunakan dalam pengelolaan limbah padat ditunjukkan dalam tabel di bawah ini yang juga menyajikan ringkasan pengalaman penggunaan mekanisme-mekanisme tersebut di seluruh dunia. Perlu dicatat bahwa mekanisme-mekanisme tersebut terkadang sulit diwujudkan jika dilihat dari sudut pandang politik. Namun demikian, karena Kota telah menciptakan dasar pengumpulan retribusi untuk pengelolaan limbah padat melalui tagihan listrik, kesempatan untuk menyesuaikan retribusi sampai pada tingkat yang diharapkan untuk pelayanan yang efektif tetap ada.

Tabel 2 – SWM Cost Recovery Options

Mechanism	**Can adequate revenues be generated?**	**Can the revenues be easily collected ?**	**Does the polluter pay more?**	**Is it politically difficult to use this mechanism?**	**Is the mechanism easily enforced?**
USER CHARGE					
Solid Waste Tax	Yes	No	Not always	Difficult	No
Volumetric Charges	Yes	No	Yes	Difficult	No
Tipping Fee	Yes	Yes	Yes	Difficult	Sometimes
OTHER RESOURCES					
Property Tax	Yes	Yes	No	Difficult	No
Business License Fees	Yes	Yes	No	Difficult	Yes
Utility Surcharges	Yes	Yes	Not always	Difficult	Yes
Grants and Donor Support	Yes	Yes	No	Difficult	No

ENVIRONMENTAL SERVICES PROGRAM
Ratu Plaza Building, 17th. Fl.
Jl. Jend. Sudirman No. 9
Jakarta 10270
Indonesia

Tel. +62-21-720-9594
Fax. +62-21-720-4546

www.esp.or.id